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DR. GORDON M. KLINE, Technical Editor
HARRIET B. JOSEPHS, Associate Editor
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modern plastics

DECEMBER 1940
VOLUME 18 NUMBER 4

MERRY CHRISTMAS

In a war-torn world, with the unfortunate peoples of many lands crushed under Mars' iron heel, with still others paying innocent, misguided tribute to his temporary prowess we are deeply grateful that, in peace, we enjoy the spirit of Yuletide.

To our host of friends here and in foreign lands as we come to the close of another year, we, the Staff of MODERN PLASTICS, pause to lay aside our pens and papers to wish all a Merry Christmas, and may 1941 cradle for all a new and better order.

When another year shall have passed, let us all hope to behold "on earth, peace, good will toward men."

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Cover color this month FIELD GREEN (Created by Textile Color Card Association)

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Published the 5th of each month by Breskin Publishing Corporation. Publication office, Twentieth and Northampton Sts., Easton, Pa. Executive and Editorial Offices, 122 E. 42nd St. (Chanin Bldg.), New York, N. Y. Phone AShland 4-0655. Mid-Western office, 221 N. LaSalle St., Room 1338, Chicago, Ill. Phone Randolph 6336. Pacific Coast Office, 427 West 5th St., Los Angeles, Cal. Also Publishers of Modern Plastics Catalog, Modern Packaging, Packaging Catalog. Subscription price $5.00 per year, $8.00 for 2 years in U. S., its possessions and South America. Canadian subscriptions $5.50 per year, $9.00 for 2 years, all other countries, $6.00 per year, $10.00 for 2 years, payable in American money or its equivalent. Price 50¢ per copy, except October issue, which is $2.00.
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Printed in U. S. A. Entered as second class matter May 28, 1940, at the Post Office at Easton, Pa., under the Act of March 3, 1879. Back numbers (except October) 3 months or more preceding current issue, when available, $1.00 each.
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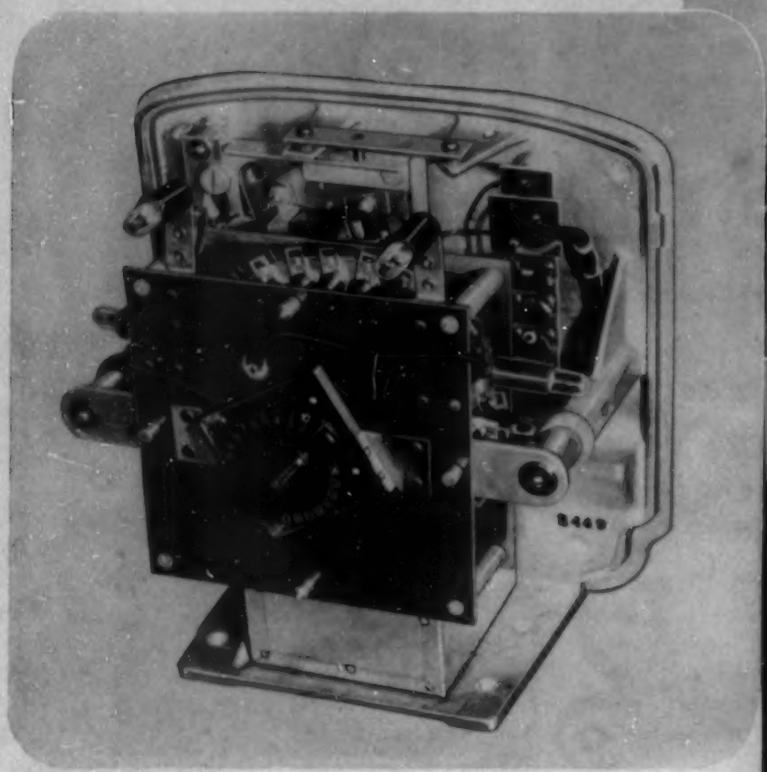

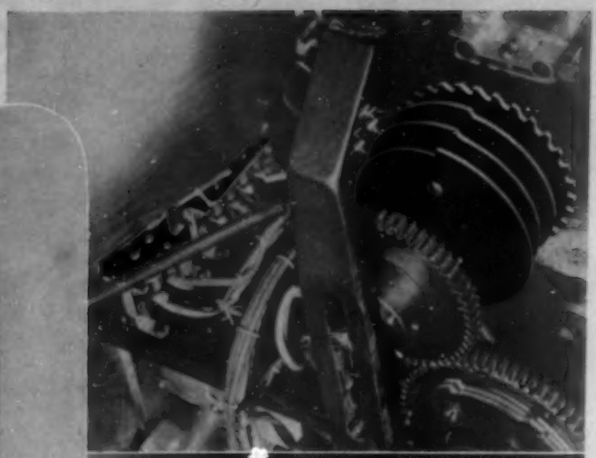

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MODERN PLASTICS
WILLIAM T. CRUSE, Editor

DECEMBER 1940 VOLUME 18 NUMBER 4

1

1—Pink Louverglas shields white fluorescent lamps to give the desired effect in the new suburban cafe of the Pennsylvania Railroad's suburban station in Philadelphia. The restaurant was designed by Raymond Loewy

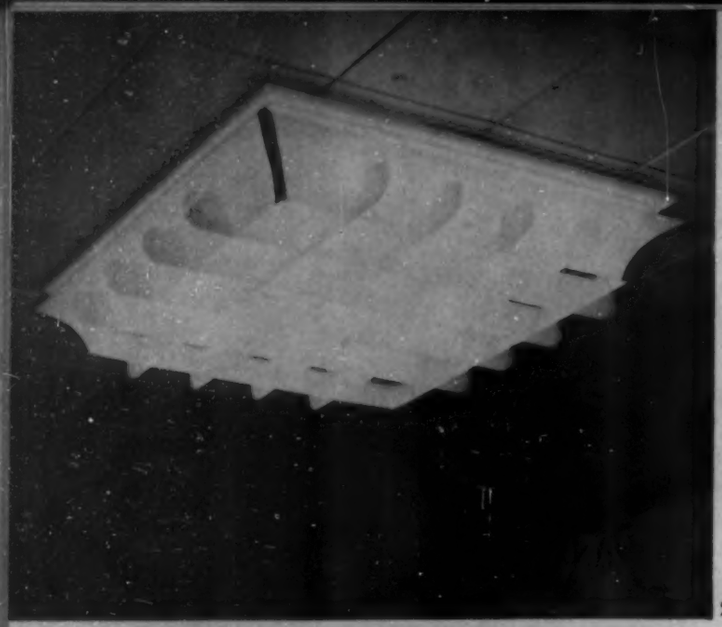
Plastics for fluorescent lighting

Various types of plastics are helping to enhance and improve the light from fluorescent lamps

THE problems of lighting, today, tax the ingenuity of the lighting engineer. His is the task of supplying sufficient light to prevent eyestrain, harmonize the light source with its surroundings and make use of all the light produced without inducing glare and uncomfortable levels of brightness. Plastics have played an important part in the field of lighting, especially in the incandescent branch. As a result, the lighting engineer and designer have found their facilities for controlling light considerably enlarged. Available in a complete range of optical characteristics from crystal clear to opaque white and colors, the significance of plastics in relation to fluorescent developments is not to be minimized in view of continual progress.

The fluorescent lamp is a mercury vapor tube similar to the Cooper-Hewitt lamp which for many years was used in industrial plants and photographic studios. The new feature is that inside the tube are fluorescent and phosphorescent powders which convert the ultraviolet rays into visible rays, greatly increasing its efficiency and multiplying its applications. The fluorescent lamp is now made in 10 colors—warm white, 3500 white, soft white, blue-white, daylight, gold, blue, green, red and pink.

When fluorescent lighting was first introduced to the public on a commercial basis about 2 years ago, more emphasis was placed upon the fact that this was a new type of light source that gave forth a better light, than



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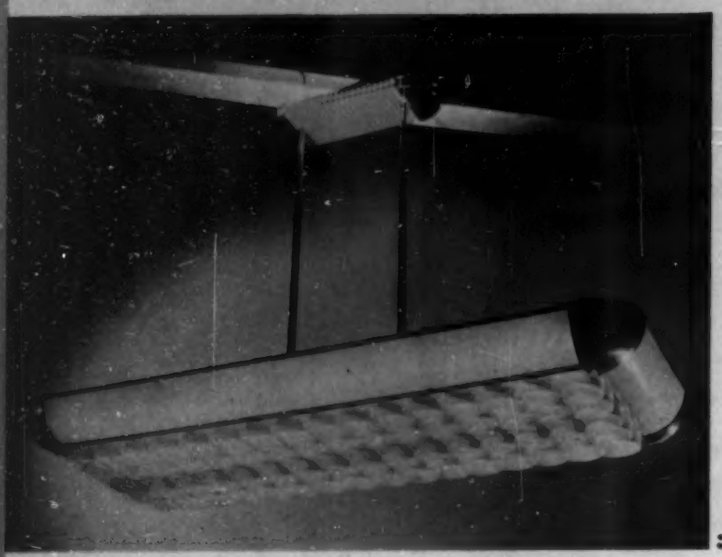


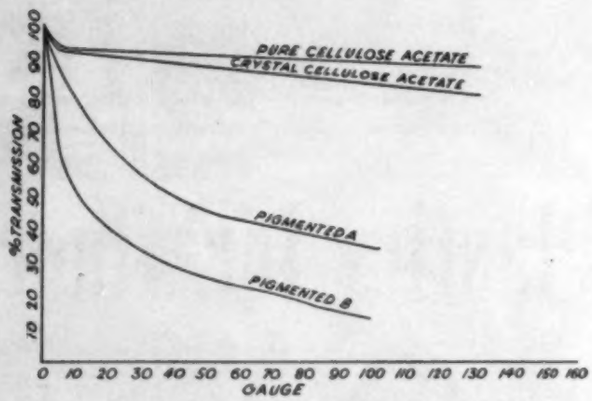
3

2—Suggested design for luminaire made of translucent Beetle by General Electric Co. 3—The Fluorogrill designed by Norman H. Vacha with circular rims to baffle the glare and hide the lamps is fabricated of Plaskon and Textolite by John C. Virden Co. 4—White, translucent Lumarith sheets are bent to shape, inserted into a metal channel and fastened by chromium bands. Fluorescent tube and auxiliaries are concealed. 5—Chart by Monsanto Chemical Co. shows light transmission properties

4

upon its decorative value. As various groups of people such as advertising and merchandising executives, architects and designers and home owners became aware of these peculiarly shaped "bulbs" and the light that seemed almost like daylight, lighting engineers and equipment manufacturers began to show some concern about the appearance and attractiveness of the units. A holder for the lamps and a place for auxiliary electrical equipment had been provided, but now provision was made for shielding and diffusing the raw light, and attention was directed toward the designing of fixtures.

Various types of glass were first used for diffusing panels and shields but plastics are rapidly replacing glass and are taking the place of enameled metal louvers. Urea plastic, well known in the incandescent branch of lighting, is equally as effective in the fluorescent field. Because of its good powers of light transmission and diffusion, this plastic is also suited for such applications in fluorescent illumination. A greater part of the initial experimentation on the use of plastics for fluorescent fixtures has been carried on with urea materials. Because this plastic has withstood tests used in conjunction with light that generates heat, it was only reasonable to believe that lighting engineers and designers would try it out with "cold light." The fact that it is proving successful is attested by many of the units illustrated here.


PURE CELLULOSE ACETATE
CRYSTAL CELLULOSE ACETATE
PIGMENTED A
PIGMENTED B
% TRANSMISSION
10 20 30 40 50 60 70 80 90 100
0 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160
GAUGE

5 LIGHT TRANSMISSION OF CELLULOSE ACETATE

Many manufacturers of plastic fluorescent lighting equipment are enlarging their facilities in order that molded urea shields and large translucent laminated sheets can be turned out in longer lengths. One firm has already begun work on a 4-ft. molded urea sleeve.

Plasties have many advantages over glass; they are lightweight and thus reduce the danger of heavy overhead fixtures. Further, plastics are easier to handle than glass and allow instant removal of shields and diffusing panels for re-lamping and cleaning. Plastics can be easily drilled, milled and machined. Glass cannot be flexed in the manner of certain types of plastics. This is an important consideration for fixtures employing plastic sheets that must first be flexed and placed into supporting grooves, after which the sheets

expand. This method of assembly eliminates hinges, catches and other costly and unsightly mechanical contrivances, as well as helping to reduce weight and the number of metal parts for mounting.

The following comparative table showing the reflection and transmission factors of various types of urea plastics in conjunction with illuminating glassware of similar quality is of interest. There is a variation in the thickness of the glasses; however, the thicknesses given are those generally used commercially.[1]

Material	Thickness (Inches)	Percent of Reflection	Percent of Transmission	Total
Dense white urea	.060	83	8	91
Alabaster glass	.189	70	14	84
Med. white urea	.048	70	20	90
Opal glass	.240	70	10	80
Trans. white urea	.048	54	40	94
Cased opal glass	.146	54	30	84
Configurated glass	.257	12	76	88
Trans. alab. glass	.245	50	32	82
Translucent urea	.048	50	40	90

Cellulose acetate[2] is another type of plastic used for diffusing panels. Since fluorescent lamps operate at low temperatures, acetate is suitable despite the fact that it is thermoplastic. These fixtures, even in long service, do not develop heats that approach the softening point of cellulose acetate.

Pure cellulose acetate possesses good light transmission as attested by its use in laminated safety glass for a number of years. In manufacturing cellulose

[1] Data submitted by Plaskon Co., Inc.
[2] Data submitted by Monsanto Chemical Co.

6

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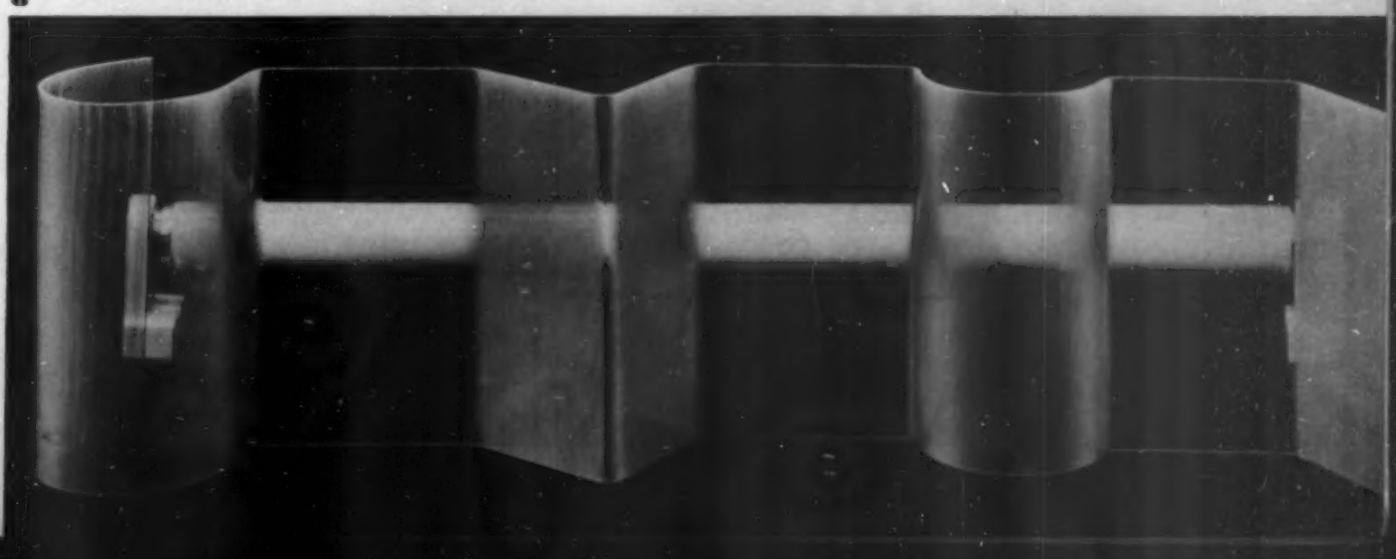

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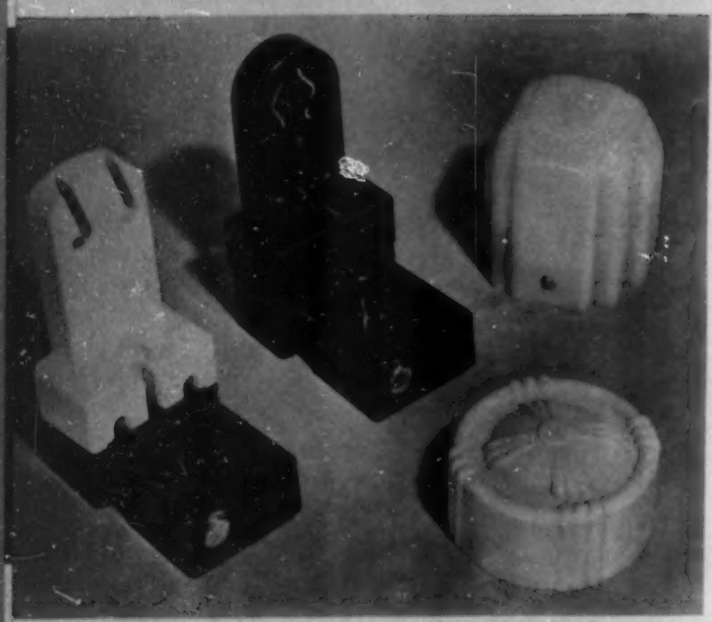
6—Two sample offices in Philadelphia's Broad St. station building have fluorescent fixtures shielded with Louverglas that combines the efficiency of direct lighting with the comfort of indirect lighting. 7—Three identical sheets of this louvered sheeting are placed at different angles so that the top appears transparent with tiny parallel hair lines in vertical position, the lower portion seems translucent, while the center appears midway between transparency and translucency. 8—Easily cut to shape and readily bent, this plastic is available in a variety of louver film patterns and colors

9



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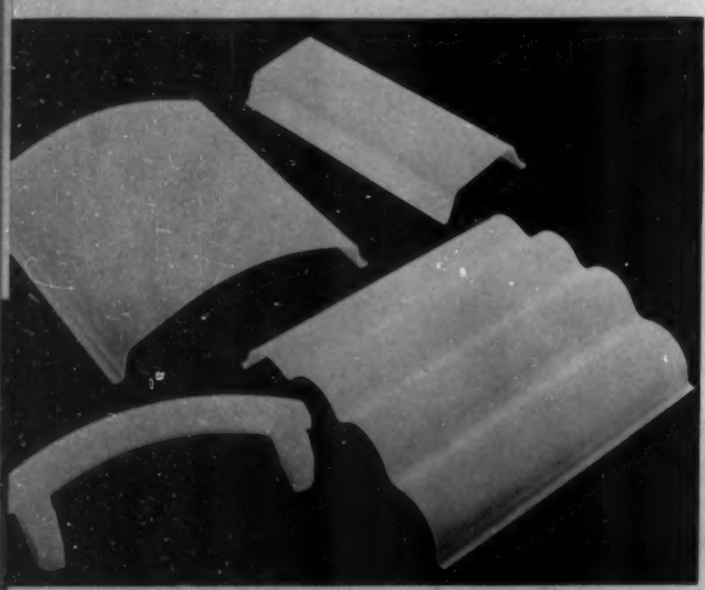


11

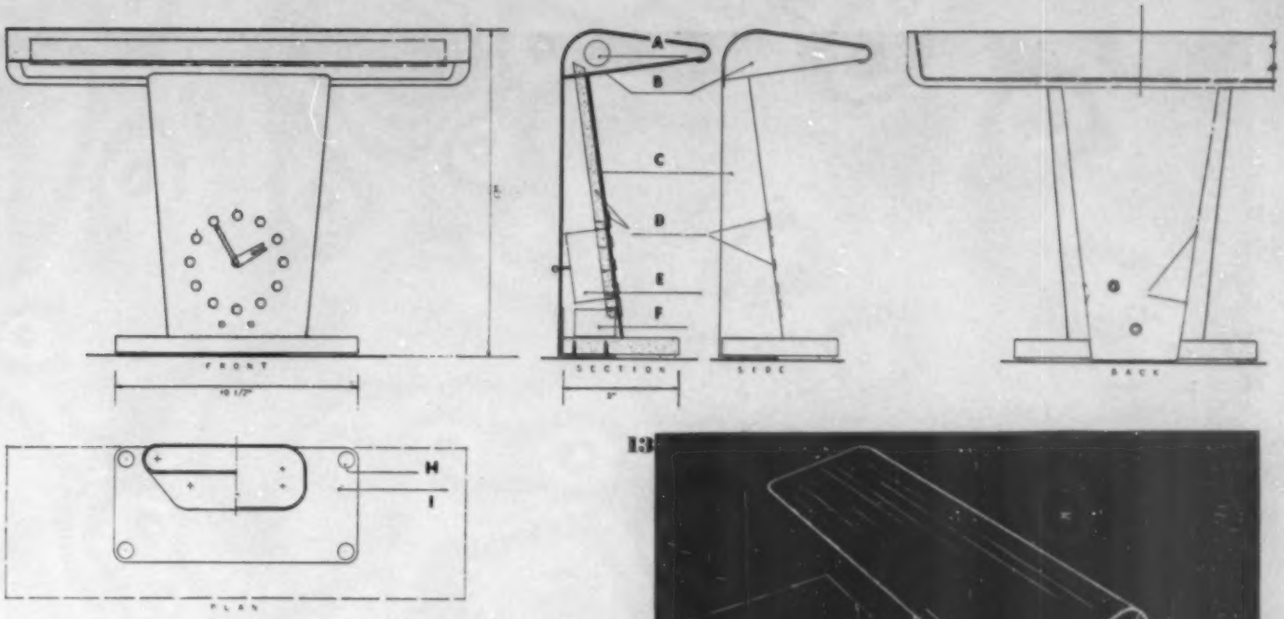
acetate sheets, a slight amount of blue coloring material is added to the stock to produce crystal material, to counteract its inherent slight yellowness. The high resulting transmission is largely a function of the thickness of the material, as illustrated by Fig. 5 in which pure cellulose acetate and crystal cellulose acetate are plotted against the percentage of transmission of light. These transmissions are measured on a Bowen-Kline Hozometer with the plastic next to the photoelectric cell. (See page 30.)

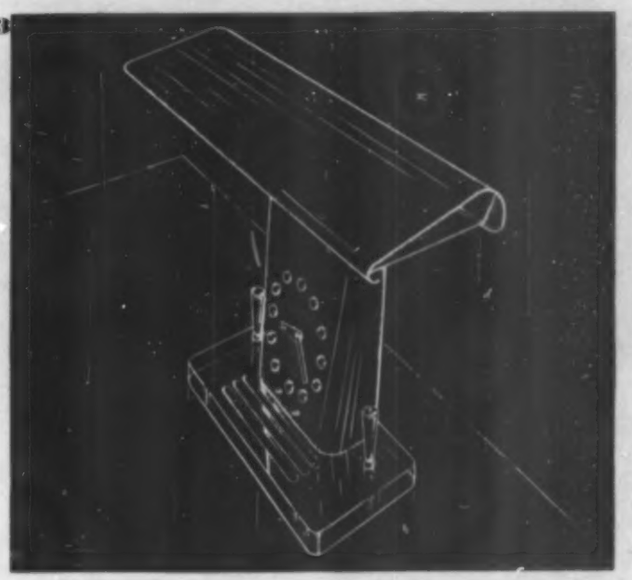
Diffusing properties in cellulose acetate may be obtained in two ways—either surface treatment or pigmenting. From a manufacturing and service standpoint, the more satisfactory method of surface treating is embossing, which allows almost any configuration to be obtained. This can be supplemented, if desired, by pigmenting the stock itself.

In weight, cellulose acetate has an important advantage. Because of the large size of the fixture as well as the weight of the reactors, starters, etc., fluorescent fixtures are usually considerably heavier than equivalent incandescent fixtures. To hang a heavy diffusing panel on an already heavily loaded fixture is to add more weight to the whole assembly than is desirable. Cellulose acetate has a specific gravity of 1.27–1.60 as contrasted to glass at 2.1–2.3. In fixtures, however, this difference in weight is far greater than would be indicated by the above, because glass is generally used in sections about twice as thick as plastic; therefore the plastic panel will weigh approximately one-quarter to one-third as much as the same size in glass. The flexible and non-fragile nature of cellulose acetate permits lighter packing cases and considerably reduces shipping costs. This is true of all of the plastics used

9—Richly grained diffusers molded of polystyrene have been developed by Edwin F. Guth Co. in white, pink, light blue, yellow and green. These snap-on channels are shatterproof, easily removed for cleaning. **10—*These lamp sockets are being molded in huge quantities of Bakelite, Beetle, Durez, Plaskon and Textolite. The circular socket crown in foreground is molded of Beetle by Waterbury Button Co. for Gruber Bros. Translucent end cap in the rear is molded of Insurok in 7 different colors for Lighting Products, Inc.*** **11—*The Safety Car Heating and Lighting Co., Inc., employs "Safety 68" (either methyl methacrylate or vinyl chloride-vinyl acetate-copolymers base) for shields on fluorescent lamps. Unsightly metal supports and catches are eliminated by flexing the plastic shade, then expanding the flanged edges into grooves of fixture. Narrow section shown in lower, left hand corner is an injection molded spacer used at joints of shades so as to provide a continuously luminous band of light.*** **12—*Cut-away shows how shields and spacers are mounted***

12





13—*Detailed drawings show a fluorescent desk lamp with electric clock designed by Morris Sanders. a—Fluorescent lamp; b—Louverglas; c—wood-veneered Robertson metal, plastic bonded; d—Lucite or Plexiglas numerals; e—electric clock; f—lamp ballast; g—spot-welding; h—Vinylite tab; i—Catalin or acrylic base, 3/4 in. thick*

for fluorescent equipment. In addition, the problem of breakage and damage in transit both for the material itself and the whole fixture is reduced. Further reductions in cost by using plastic instead of vitreous material are possible where the diffusing panel is curved. Since the cellulose acetate can be curved to shape from sheets, the cost of expensive molds is obviated.

In using embossed cellulose acetate in fluorescent fixtures, special molds or tools are not required. Small quantities, down to 200 lbs. can be made to specification. Fabrication consists of cutting and bending to shape. One stack of flat sheets serves as a source for diffusing panels of many different sizes and shapes. With cellulose acetate, therefore, good light transmission is possible, reasonable freedom from brightness and glare is obtained and appearance is improved.

New achievements in vision control are made possible by a type of cellulose acetate sheeting that combines the efficiency of direct lighting with the comfort of semi-direct or semi-indirect lighting. Very thin parallel translucent louvers[3] or "slats," either white or colored, run through the depth of a clear transparent sheet at right angles to the surface, thus combining in large measure the diffusion obtainable with an opal material with the directional efficiency obtainable through the use of a clear material. This plastic is believed to be one of the best materials found to date for fluorescent lamp direct lighting fixtures, an application for which it is primarily intended, since the continuous linear source of light requires a method of directional control.

[3] Data submitted by E. I. du Pont de Nemours & Co., Inc.

According to the angle from which smooth-surfaced, louvered plastic material is viewed, it appears as a transparent sheet with fine, parallel, translucent hair lines, which are the louvers, running through it; or as a completely translucent surface due to the louvers overlapping one another like the slats of a closed shutter; or in various proportions of translucency and transparency or cross-hatching between these two. In proper fixture design the sheeting appears translucent within the normal field of vision, cutting off all glare. Direct light rays are confined to the area which it is desired to illuminate. With these rays transmitted as they are, directly through the transparent sections between the louvers, extremely high light transmission is retained. In most cases the sheeting should be used with louvers at right angles to the length of the lamp.

A variation is the embossed type, differing only in that one surface of the plastic sheet has a prismatic finish. Forty tiny light-controlling prisms per inch serve to obscure the interior construction of the fixture, viewed from any angle; and to break up the light so that eye-straining reflections or bright images are minimized. Both the prisms and the louvers are so small that neither is perceptible as such in fixtures viewed at normal distances. (*Please turn to page 76*)

COLOR PLATES AND PHOTOS, COURTESY TENNESSEE EASTMAN CORP.

Sweet and lovely in her best dress and bonnet, this baby doll awaits the Christmas morn beneath the glistening tree. Her molded cellulose acetate head has given her new beauty as well as a longer life

Oh, you beautiful doll!

Injection molded cellulose acetate provides practically unbreakable heads with life-like facial detail

EVEN as plastics are born in the test tubes, dolls are the children of research. Night has fallen on the era when a porcelain, bisque, rubber or homemade cloth doll will satisfy all the whims of doll-loving youngsters. Like their parents, children are modern, too. Today, the dolly must be as trim and well turned out as the children who fondle them.

Recently, one of the leading doll manufacturing concerns in this country sensing juvenile America's appreciation for finer dolls, tried something new in an attempt to fulfill this demand. Their program led them up many different avenues for materials, to many scientific halls for information and to several industries for production ideas. This company, we are told, pioneered in using human hair, was first to use rubber parts for legs, arms and torsos. They were early in the field with "sleeping eyes"—and eyes that flirted. Now, they are the first firm to have produced a doll with an injection molded plastic head. The trial and error period of this project took about four years, but it was time well spent in finding the way, through conducting experiments with molds, working out molding methods and perfecting coloring materials.

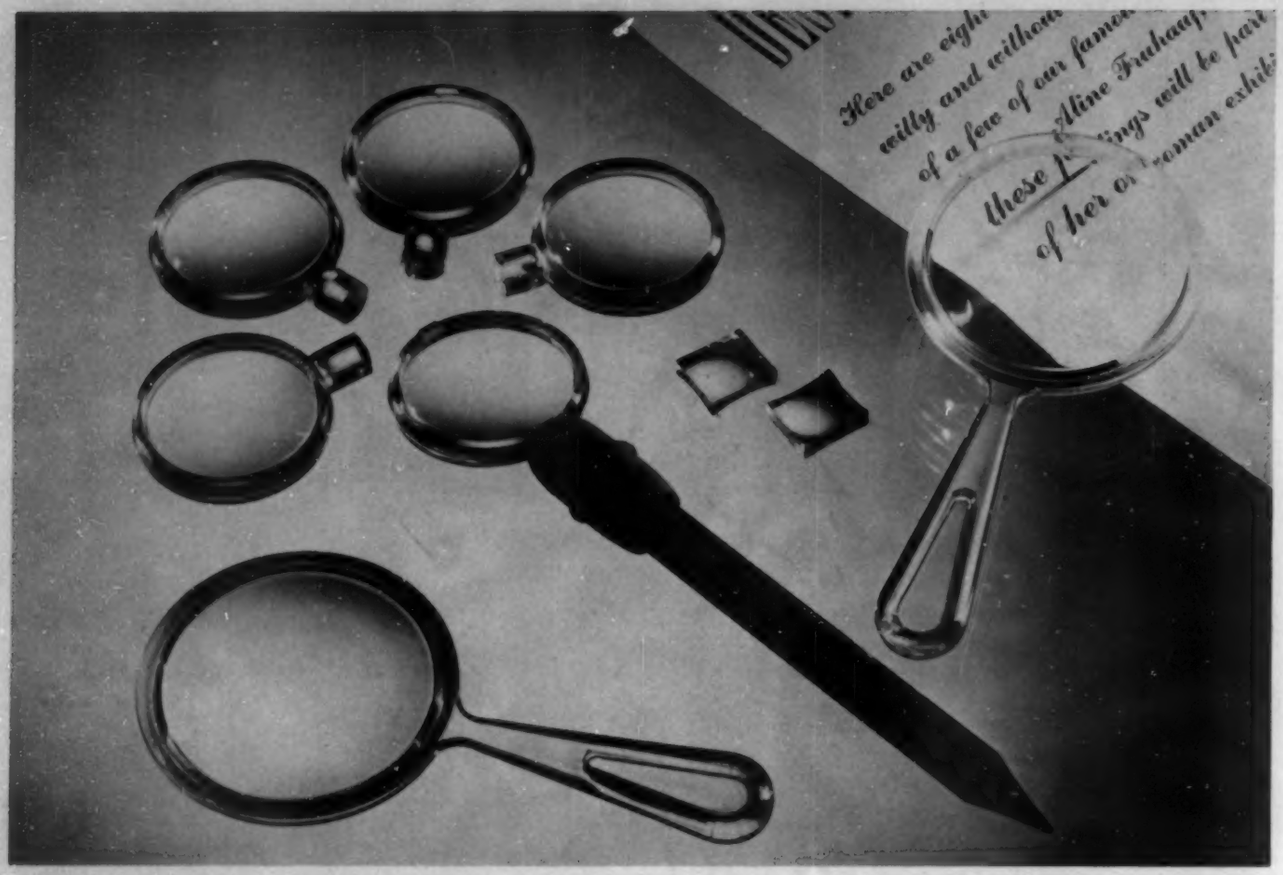
The earliest experimental heads were injected on converted rubber molds. The length of these moldings from the base of the neck to the top of the head was $3^{3}/_{4}$ inches. Those now being molded measure $5^{1}/_{2}$ inches. During this early stage the company experimented with many kinds of materials. The selection depended upon certain important factors such as color, cost and durability. Color was of foremost importance. Without an appealing basic color, plastics would have held little interest. Cost also had to be weighed against other materials. It could be slightly higher and still throw the scales into a favorable balance, since other qualities were to be found in plastics that are not present in some of the other materials investigated. Toughness was another essential. The selection was finally cellulose acetate, developed by Monsanto Chemical Co., and Tennessee Eastman (*Please turn to page 84*)

1

2

3

1—Craftsmen at the Ideal Novelty and Toy Co. fasten the eyes in the mounting posts that are molded right into the front section of the head. 2—Plastic heads are sprayed with special lacquers for proper coloring. 3—Final assembly of the lightweight, realistic heads is matter of seconds



1—*Lenses designed for varied purposes are held to rigid optical tolerances. These pencil-top magnifiers are injection molded of Crystalite and polystyrene by Waterbury Button Company*

Molding lenses

by C. H. WHITLOCK

Author discusses solutions to problems encountered in molding clear, optically correct, plastic magnifying glasses and lenses

OF ALL the items made from the various synthetic plastics very few have created the interest that has been given to the plastic lens since its entry into the molded plastic field. This has been due in part to the fact that the Government has been using a great many plastic lenses in gas mask assemblies. There have been other applications, however, just as important and interesting.

It must be stated that, for the present, the use of plastics for lenses has very definite limitations. The materials that are available, even though a great improvement has been made in the past two years, are not suited for all types of lens applications. The most important reason is that the surface hardness of the available materials when molded is far from that of glass and consequently is subject to scratching.

It is possible to obtain a harder surface on plastic lenses from materials that are compression molded than those molded by injection. Careful consideration should be given to the particular application of the molded lens and to choose the molding method which will give the most efficient results. Applications where the lens surface is exposed and would be subjected to cleaning should be considered from the standpoint of the effect that slight scratching would have on the efficiency of the lens. Some of the harder materials will stand considerable rubbing with lens cleaning tissue without any visible scratching.

Molded plastic lenses have been used for spectacle lenses, protective goggle and mask lenses, and similar applications where slight scratching would not impair their efficiency to any great extent. We find practically

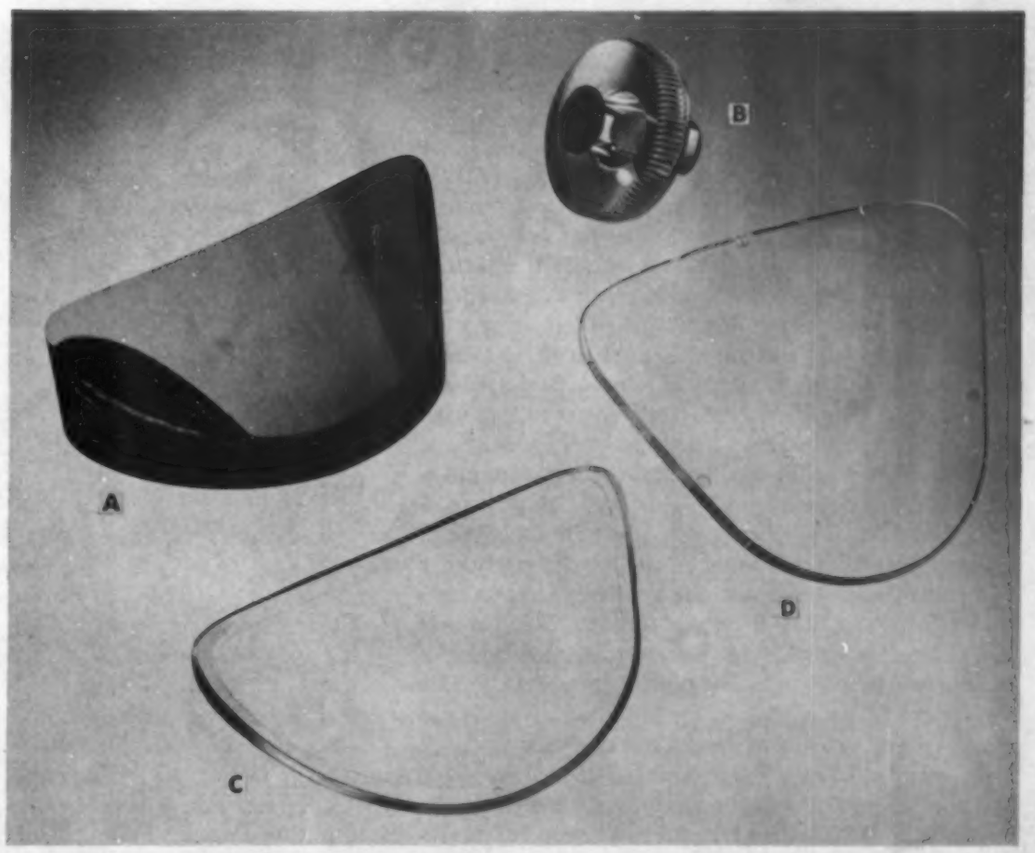
no plastic lenses used in optical or photographic equipment. There are two main reasons for this, one being the tendency to scratch and the other a fact that no plastic lens has yet been produced that has a so-called "optical surface" molded thereon. Optical surfaces have been ground on plastic lenses, but this takes away the only advantage which a plastic lens has over the glass, lens, namely, that it can be molded to shape and curvature without any further work on the lens, thus saving the cost of grinding and polishing.

When we say that a molded lens has not yet been produced with a molded optical surface, we do not insinuate that it cannot be done. In fact it would not take a great deal of effort to produce such a surface. Yet it will not be the molder alone who will accomplish this feature. It will have to be done in cooperation with the optical industry. This is easier said than done, for the cooperation of the optical industry is not going to be offered with any degree of haste, especially when such cooperation will likely cut them off from a source of business which they have had in the past. The molder should realize this and confine his efforts to the high productive, cheap lenses used in the toy field and other fields where optical quality is not the first requisite, leaving the more intricate lens applications to the optical industry.

The most likely field for plastic lenses is in the toy industry with such items as microscopes, projectors, cameras, field glasses, magnifiers, picture viewers, and the like. The molded plastic lens can compete with the glass lens for this type of application and fits in well with the production setup of the average molder. The plastic lens should not be confined to the toy field entirely as there are millions of sun glasses made every year in the lower price class that have very inferior glass lenses which are detrimental to the eyes of the wearer. A plastic lens can be made that will compete in price and be ever so much easier on the eyes of the wearer. There are, no doubt, other fields that are just as applicable which have never been uncovered.

It will be interesting to know what has gone on in the past concerning the construction of molds, the type of equipment used, and general information covering the manufacture of plastic lenses. It must be concluded that the success of the molded plastic lens depends on the mold more than anything else. The results of a poorly constructed mold cannot be corrected in the molded lens. Lenses must be made with as little finishing after molding as possible. The trimming of the flash or removal of the gate is all that should be required. The least amount of handling results in keeping the number of rejects down. (*Please turn to page 86*)

2—(*a*) *Steel lens insert is machined and polished to precise dimensions.* (*b*) *Optical technique is used in molding a crystal-clear control knob. Center indentation is wiped in with brilliant red.* (*c*) *Injection molded Crystalite goggle lens measures 2.06 in. by 3.21 in. by 120/1000 inch.* (*d*) *Pear-shaped, new type molded of Lucite measures 2 1/8 in. by 3 3/32 in. by 100/1000 inch*



PENDANT FIXTURE

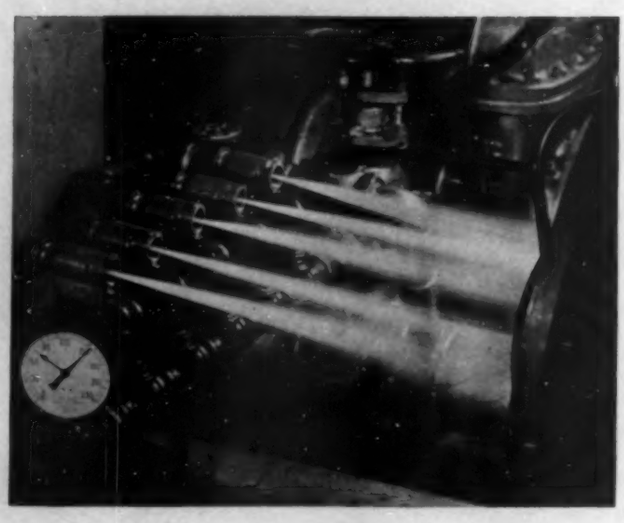
A luminous plastic bowl pendant fixture designed for commercial interiors retains the inherent functional characteristics of its predecessor with an opal glass bowl. A new construction had to be developed to provide the urea plastic bowl with sufficient ventilation in order to keep it within safe limits of operating temperature. The plastic bowl serves as a baffle surrounding a bowl-silvered lamp. When lighted, it becomes luminous thereby making the fixture least conspicuous by avoiding the heavy and dead appearance of an opaque bowl of the conventional type. The $19^{1}/_{2}$-in. diameter bowl is curved slightly in order to follow the light distribution characteristics of the bowl-silvered lamp, thereby giving this bowl uniform luminosity without intercepting any light of major intensity. The fixture's efficiency is over 90 percent according to a report issued to the manufacturer by the Electrical Testing Laboratories. It is claimed that the use of a plastic has reduced the manufacturing cost by 40 percent. The shipping weight has been reduced by 60 percent, with breakage brought down to a minimum.

Credits: Designed by Kurt Versen Co. and molded of ivory Beetle, by Bryant Electric Company.

PRODUCT DEVELOPMENT

MOLDED NOZZLE

A pump manufacturer who decided to develop and market a jet pump began an investigation of the various weaknesses of this type of equipment. One of the two parts subject to erosion and wear due to the extremely high velocities with which they work, is the nozzle. The nozzle creates the high velocity, so the manufacturer decided to conduct an accelerated test using various materials to determine which was best fitted to do a 100 percent job. This test was conducted in the following manner: 5 manifolds were made up each fitted with different nozzle materials. Number 1 used hard bronze, No. 2 hardened cold rolled steel; No. 3 acetate butyrate; No. 4 a second type of plastic material, and No. 5 a third plastic. The photograph here shows the set-up. All manifolds were connected through a common header to a pump capable of producing a velocity in the nozzle throat in excess of 100 ft. per second. Each nozzle throat has its own pin gage ground to the exact size of the nozzle opening. The experiment was carried on for a sufficient period of time at the accelerated velocity to equal a period of 5 yrs. at normal operation for any unit. Upon completion of the test, new pin gages were made and their diameters measured with micrometers to determine the wear which had taken place. The aceto-



butyrate nozzle revealed no wear whatsoever and was in perfect condition when the test was finished. This material not only maintained its size, but has the added advantage of being corrosive proof and possesses a certain degree of resiliency and abrasive resistance.

Credits: Tenite II molded by Plastic and Die Cast Corp. for Pomona Pump Co. and Crane Company.

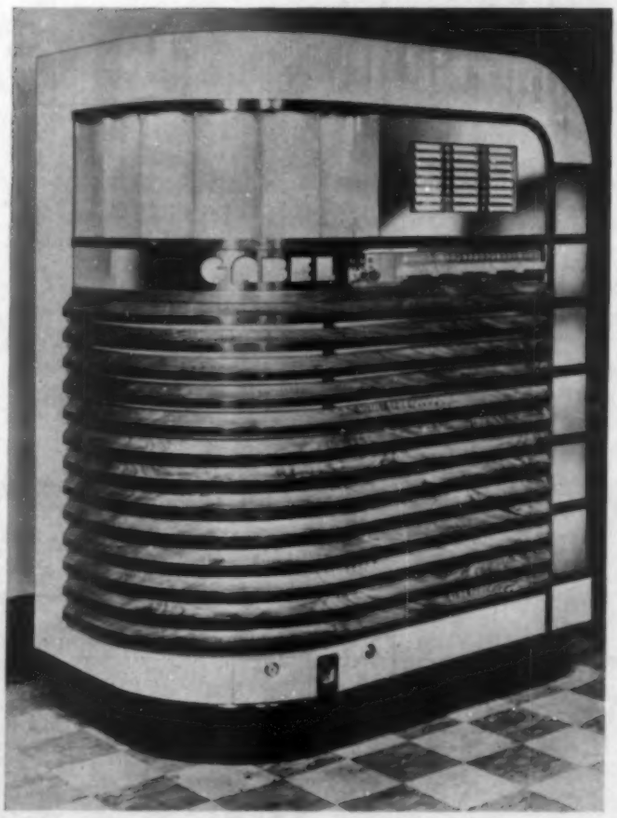
MUSICAL REED

Musicians have always wanted a really permanent reed, one that would be reliable and non-fragile. Attempts have been made to utilize hard rubber, to treat cane and metals, but with no success. The need persisted, however, until finally a manufacturer of musical accessories turned to plastics. Made of polystyrene, reeds are being accurately molded right down to the narrow tip which measures .005 inch. Many molding problems were encountered and a great deal of experimental work had to be done in order to establish the correct molding cycle and suitable hardness of the raw material. The contour of the piece called for a number of corrections in order to obtain the proper flex. One of the major problems was to obtain a flow of material down to the narrow tip and at the same time preserve a plate glass flatness on the underside of the reed.

This plastic reed is guaranteed for one year of normal usage as against an average lifetime of one week or a month for the cane reed. The reed will not absorb moisture and become soggy and limp. One of the most important characteristics is the fact that its vibrating properties remain constant, while the cane reed has a tendency to change slightly in operation.

Credits: Monsanto polystyrene, molded by Northern Industrial Chemical Co. for Musical Accessories Co.

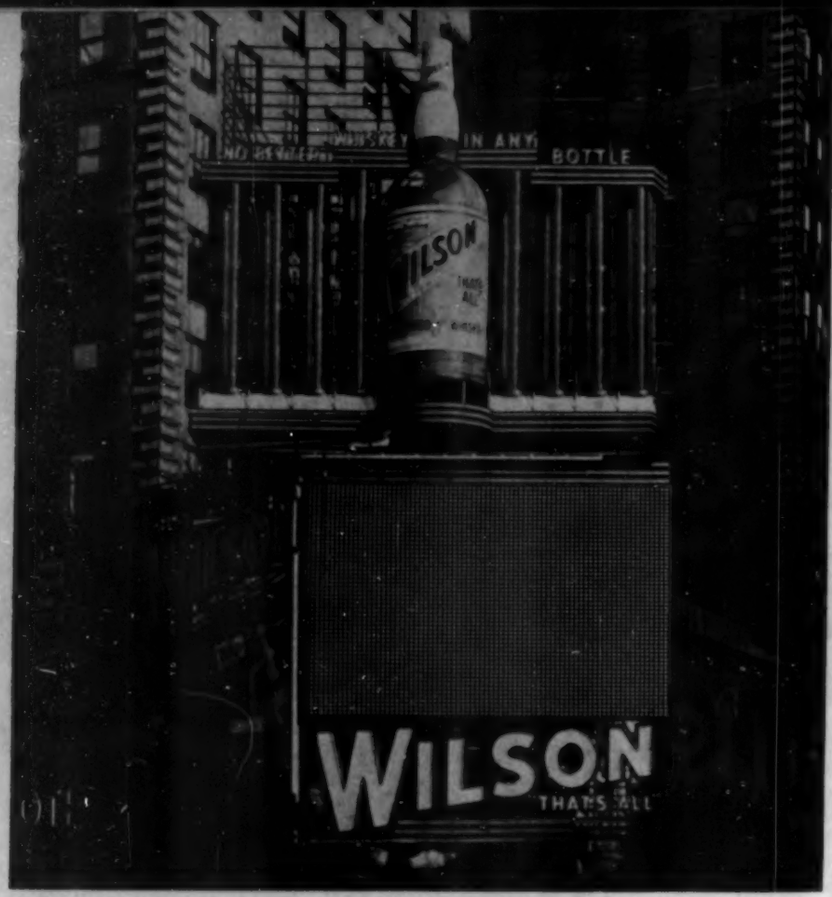
PRODUCT DEVELOPMENT



RECORD PLAYER

This coin record playing machine, represents a new trend in styling. Devoid of superfluous ornamentation, there is a combination of good architectural lines plus simple designing supplanting the grotesque scroll work generally found on these units. Materials that were decorative enough to attract attention as well as being durable were required for the construction. Plastics were chosen for these reasons; also because the plastic surfaces are pleasant to the touch, and easily cleaned. The fact that there is no surface finish to wear off or chip was a major consideration. The cabinet measures 55½ in. high, 40 in. wide, and 24 in. deep. The weight of the record player when crated for shipment is 400 pounds. Points of construction in which plastics have been used are: buttons of record selector, and blue and green square panels which form the right-hand corner of the machine are cast phenolic. Tomato red, cast phenolic fluted pieces forming the upper panel on the left are 10 in. high and measure 25 in. across. They vary in thickness from ⅜ in. to 1 inch. The back of the grill, the letters and louvers are vinyl resin plastic.

Credits: Bakelite cast phenolic, Vinylite; Designed by Brooks Stevens; fabricated by Colonial Kolonite Co. for John Gabel Manufacturing Company.



1—*Towering above Broadway at 46th St., Douglas Leigh's new Wilson whiskey sign introduces eight 20-ft. cylindrical fountains fronted with curved sheets of transparent Plexiglas as a new note in sign construction. Easily cleaned, the plastic protects passersby below from being splashed.* **2**—*Sheets 45 in. by 65 in. cemented together to form half-cylinders arrive from the factory in long, narrow crates (below)*

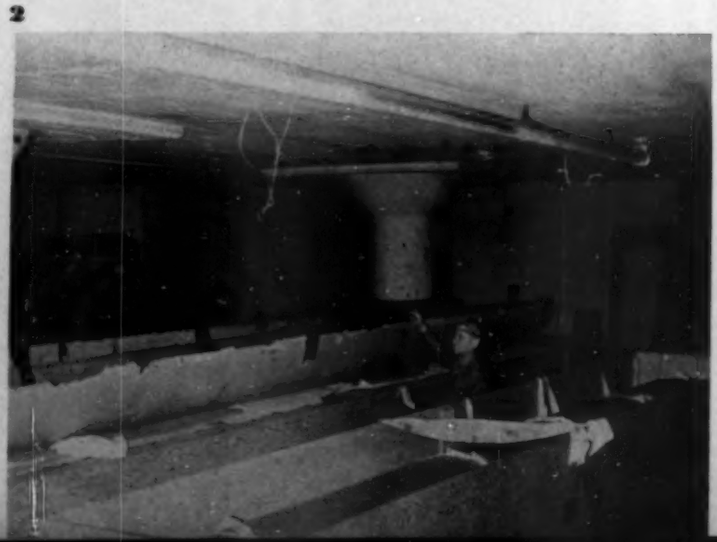
Making Broadway brighter

ONE of the most sensational electric signs ever to shed its brilliance on the Great White Way has made its bow to Broadway using 800 sq. ft. of acrylic plastic material. The sign is the creation of Douglas Leigh and advertises Wilson whiskey. Eight large fountains which spout water 20 ft. high are enclosed with sheets of transparent acrylic.

The sign is a three-panelled job, with one panel on top and two underneath. On the top panel are the fountains; centered between these is a giant 35-ft., three-dimensional bottle advertising the liquor. This is surrounded by a live boxwood hedge and flanked with 4 fountains on each side. On one of the lower panels is a large animated-cartoon mechanism said to be the largest use of photocells in the world. This screen has eight times more detail than any previous one, which means that the characters of the animated cartoons appear more rounded than square. On the third panel is a whiskey-and-soda "pouring" effect in colored bulbs where a highball is mixed every minute.

This is the first time that real fountains have ever been used in a sign on Broadway. Enclosed in the plastic tubes, there is no chance that the watery spray will fall on passersby below. Fifty-six colored flood lights play on the fountains which spout into a mushroom effect. When the watery mushrooms break up, myriads of multi-colored watery bubbles float in the transparent tubes. The pumps that spout the water are flexible, so that each one of the eight fountains rises to a different height, thereby making a variety of

2



geometric patterns. As the fountains spout the water, it drops down into a metal container from which the pumps pump it up again. In other words, the same water is used over and over again for 24 hrs., and then changed. The total amount of water pumped per minute is 2000 gallons.

The fountain enclosures are made of 1/4-in. thick sheets. These units are the largest acrylic assemblies ever made. Six sheets 45 in. by 65 in., the largest transparent plastic sheets available, were heated in large ovens until they were soft and flexible. They were then laid across semi-cylindrical wooden forms and allowed to cool in shape. Then the 6 pieces were cemented together with transparent acrylic cements to form sections 3 ft. in diameter and more than 20 ft. long. The fact that the plastic is unaffected by aging and weathering and that it will retain its transparency indefinitely made it a "natural" for this job. Shower-bath attachments have been installed near the top of the cylinders so that any dirt or mud can be rinsed off at regular intervals. Small air holes in the cylinders keep them from frosting inside, and a mixture of anti-freeze keeps the water from freezing in cold weather. Thus, at all times, spectators will be able to appreciate the full beauty of the water and light spectacle, and at the same time be protected by the plastic from a too realistic effect of the fountains.

The half-cylinders were made up in the factory of the manufacturer, and shipped in 20-ft., long narrow boxes. Trucks then drove them to the sign location where they were hoisted, as complete units, to the roof of the building. The reverse side of the fountain enclosures is made of blue colored steel for reflective purposes. The designer states that he chose a plastic for the fountains because it shows no weathering effects, is practically unbreakable and easily kept clean.

While this colorful water spectacle takes place on the top panel of the sign, electric animated cartoons are projected on one of the lower panels. Because of the great improvements in the mechanism, these cartoons are more than ever like the well-known movie cartoons, except that on the sign, the cartoons are turned into electric lights by the magic of photocells. The entire sign is 4000 sq. ft. in size, and includes among other things, 14,000 sq. ft. of porcelain, 100 miles of wiring; 10,000 lamps, 4104 photocells and 2000 ft. of neon tubing—and the 800 sq. ft. of acrylic plastic.

Broadway has been promised a new show every month. For the sign's debut there was a comic version of "The Three Bears"; a review of Americana consisting of views of Washington, Lincoln and the White House, with an American flag in electric lights waving in the background; and a cartoon called "The Sport of the Month" which happened to be log-rolling.

The sign was designed to outshine anything else in Times Square, and plastics are helping to make this dream come true.

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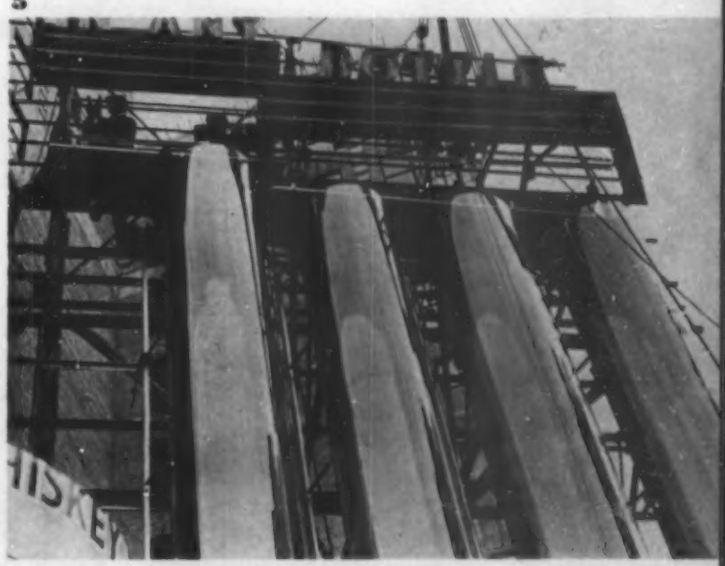

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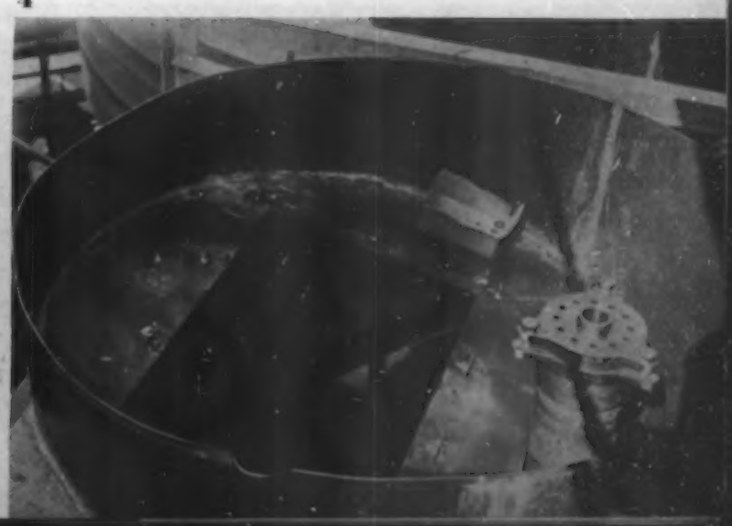
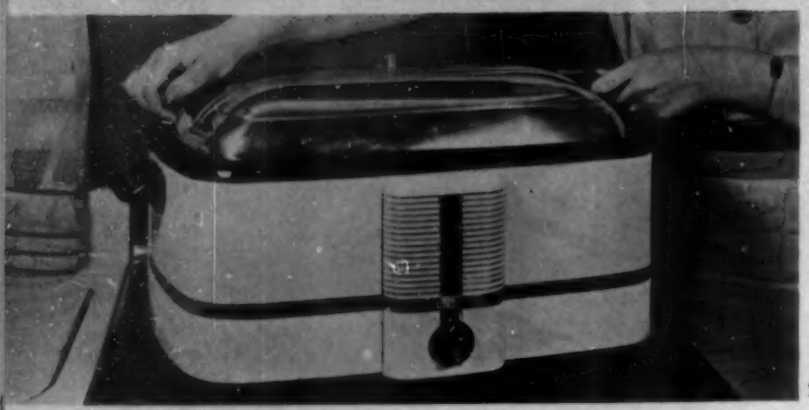


3—For reflective purposes, blue colored steel semi-cylinders are placed over the back of the fountains to form complete columns with the plastic fronts. 4—Looking into the base of one of the 20-ft. Plexiglas shafts. 5—An idea of the brilliance that the plastic adds to this sign can be gained from this view which was taken during construction. Shower-bath attachments, anti-freeze mixtures and small air holes to prevent interior frosting are maintenance aids

PLASTICS IN REVIEW

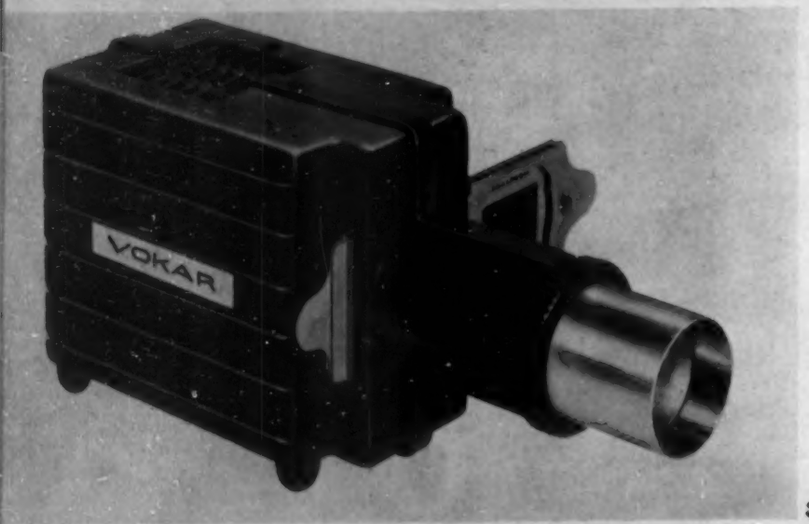
1

1 Greetings in plastics—three dimensional Christmas cards by Dorothy Simmons include a winter scene enclosing a "snow storm" of powdered acetate, a chain of transparent square each with a letter. Pine tree-signature sample is from Otto Lorch's line of appliqued cards, and the hobby horse folder from Celomat Co.'s printed assortment. All are of Lumarith



2

2 Tel-a-cook lights in various colors indicate the cooking temperatures on this General Electric automatic roaster. Automatic thermostat knob of molded Plaskon carries temperature markings, and heat-resistant handles of black Textolite on the lid and body, permit easy handling without burning fingers



3

3 Handsome, inexpensive Vokar 100-watt, 35-mm slide projector producing a clear sharp screen image, compares in operation with higher priced projectors. Two-piece housing with assembly standards for lamp, reflector, lens and slide holder are precision molded of Durez by Chicago Molded Products Corp. for Electronic Products Corporation

4

4 An impressively simple setting for quality merchandise, a transparent Lucite chest highlights and reflects the silverware itself for display beauty. Swedlow-Lehman fabricate it for International Silver Company

5 Emulating ancient Chinese playing pieces, "border-tone" game tiles of white Catalin framed by a slender 1/16 in. border of darker colors, are produced by a new casting technique. Patented design by Metro Mfg. Company

6 In red, white and blue, the Patriot portable radio marches into Emerson's new line. Cabinet of Opalon is fabricated by Ortho Plastic Novelties, Inc. Horizontal grille, star-trimmed

knobs and pointer in contrasting hues are injection molded of Fibestos by Worcester Moulded Plastics, Inc. Spring cushioned handle and inclosed super-loop antenna for increased sensitivity and portability. Red or blue cabinets also

7 For hard-to-handle half-gallon and gallon size jugs, Continental Say-When dispenser cap pumps liquid out from bottles in upright position. A downward pressure pours an even steady stream in desired quantities. Cylinder top and base are molded of Plaskon by General Industries Co. and tubing is of Vinylite—both immune to fruit acids and alcohol

8 Convenient for travel or daily use compact Kleen folding toothbrush fits into purse or pocket. Handle and case are of cellulose acetate and nitrate injection molded, bristled and assembled by Insel Company

9 In the groove—ten cigarets lie in individual sections in a dainty hinged transparent cigaret case. Designed by Everett W. King, it is molded of Crystalite and Lucite by Thomas Mason Co. for Mavco Sales, Inc. Colors are transparent water-white, ruby, emerald, sapphire and tortoise-shell

10 Boutonniere display for customer selection has 12 individual rigid, transparent Vuepak containers set in three decks. Rods of Monsanto cellulose nitrate cemented together form the sturdy frame. Fabricated by H. Pederson Mfg. Co. for Sims of Hollywood

11 Push-button transparent salt and pepper cellars control the flow and prevent clogging. Contents are always visible and the cover lifts off for refilling or cleaning. Molded of Bakelite cellulose acetate by Worcester Moulded Plastics, Inc., for Cramer Company

12 Bookmaster, expanding rack, holds 12 volumes in one compact unit which may be lifted bodily for dusting. Books are supported on polished copper tubes with a general spring tension inside which extends or contracts the sides as books are added or withdrawn. Ends are of Insurok with a Catalin center inlay. Made for Replogle Globes, Inc., by Richardson Company

For manufacturers' addresses write to the Editor, enclosing a self-addressed stamped envelope for reply.

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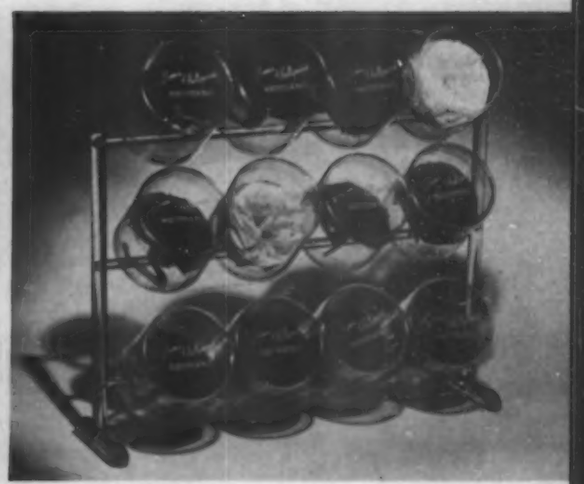

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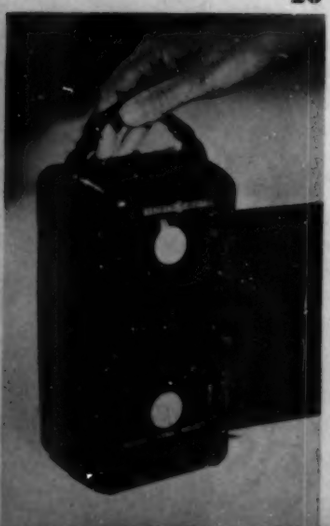


13 This is Ima Litehed, a member of the Howlite family with a Bakelite cast phenolic head that lights up when you turn it. The penguin and the clown are ideal for use on a bedside table where a soft glow is desirable. Bodies are of wood and other shapes and sizes available include flashlights, canes, night and closet lights

14 Streamlined and easy to handle, this new steam iron steams as it presses. A control gage beneath the handle can be set for such materials as rayon, silk, wool and cotton. Fitted into the front of the handle is another control gadget. Handle is molded of Textolite by General Electric Co. for Waring Corporation

15 Hobbyists and home craftsmen will be delighted with the kit of Monsanto cast phenolic plastic materials put out by U. S. Plastics Craft Corp. There are two types available: one, complete with an assortment of plastic, tools, patterns and instruction sheets; the other is designed for serious projects. Priced from $1 to $5 and bulk assortments are available for replacement

16 Good looking and long wearing, this modern soap dispenser holder will not chip, crack, tarnish or corrode in use. It is molded of black Tenite. Easy to clean, the plastic will retain its lustrous appearance and permanent finish. Molded by Modern Plastics Co. for Bobrick Mfg. Corporation

17 Designed to protect your loveliest sterling silver, this Durez tray will hold various patterns and fit nicely into the buffet drawer. A welcome substitute for loose velvet, this unit is easily cleaned and the plastic will not tarnish the silver. Molded by Northern Industrial Chemical Co. for Towle Mfg. Co.; designed by John Alcott

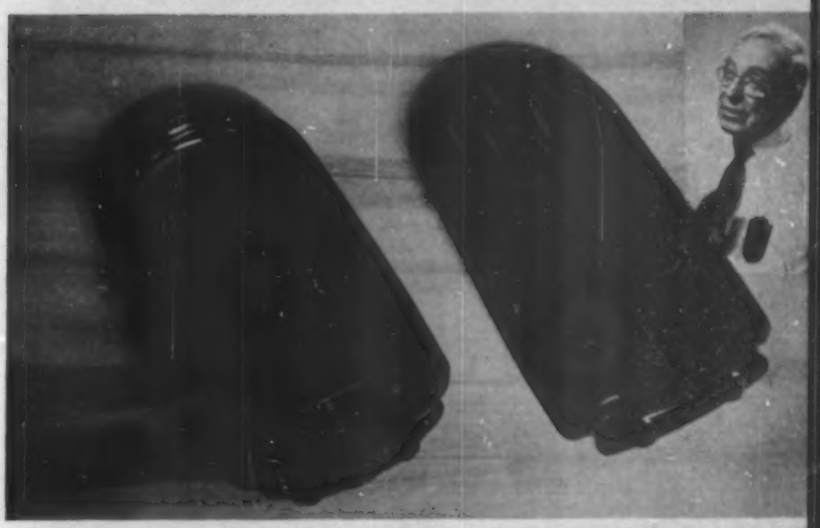
18 Your baby's first shoes, scuffs, wrinkles and all can be preserved as a keepsake and mounted on bookends, paper weights, etc. Inscriptions, such as birth date may be printed on the shoes and permanently sealed with a transparent plastic that gives the shoes a stiff supporting structure. Princess Products Co. developed the process

19 Striking a smart, modern note in radio design, this ivory model is pleasing with its suggestion of height. Four selector buttons are within easy reach with a speedometer type dial that is readable at a glance. It is molded of Bakelite urea by Universal Plastics Corporation for De Wald Radio Mfg. Co. Designed by Harry Preble, Jr.

PLASTICS IN REVIEW

21

20 New, camera-type, battery-operated radio has a translucent Lumarith, piggrain-leather-design case with the various control knobs molded in contrasting colors. Set is operated by a switch that opens the door and turns the General Electric radio on at the same time. Self-contained aerial is concealed in the hinged lid



22

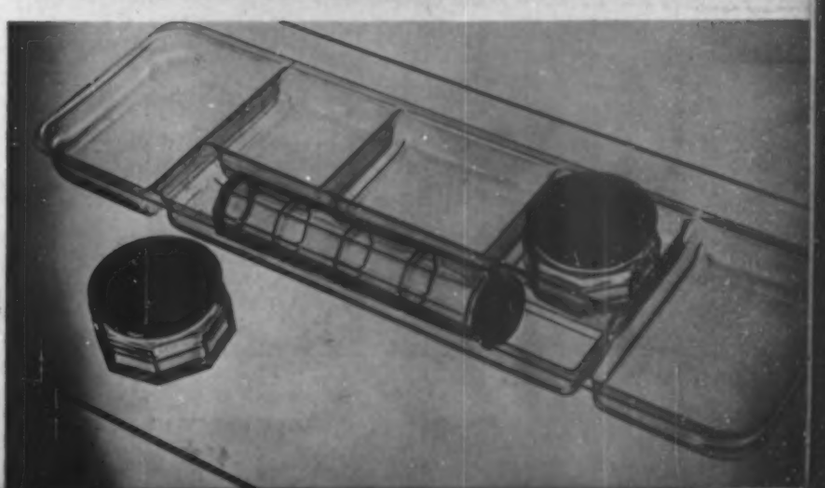
21 Automatic in action, this double-duty Multi-Shaker unit is designed for salt and pepper or other condiments. Shaker has regulated flow and is sanitary and easy to clean. Plain, as well as 2 and 3 color tone combinations are available. Molded of Plaskon and Lucite by Chicago Molded Products Corp. for Thelma Hull, Incorporated

22 "Duraton" is a hearing aid that is outstanding for its efficiency, lightweight and attractive appearance. Scientific advances in such instruments have helped to whittle down the size, and the use of molded plastics insures long life for color and finish. Unaffected by perspiration, skin oils and constant handling, this unit is molded of Durez in two complete pieces for C. L. Hofman Corp. by Auburn Button Works, Inc. Inset shows compact size

23

23 Here's a Christmas card box that need not be cast aside once all the cards are used. Measuring 4 in. by 5 in. by $1^1/_4$ in., the box can be reused for jewelry or other items. It is available in ivory, red, black and green and combinations of these colors. It is molded of Beetle and Durez by Northwest Plastics, Inc., for Buzza Corporation

24 Be smart as well as neat with a crystal-clear dresser tray that has compartments of various sizes and shapes to hold your aids to beauty. It is fabricated of Plexiglas by Croasdale and de Angelis for Lewis P. Weil



24

For manufacturers' addresses write to the Editor, enclosing a self-addressed stamped envelope for reply

PLASKON

the first better sight—

IT'S HAPPENING with increasing regularity—the selection of Plaskon Molded Color to put beauty and service into new products designed for great public appeal!

This month we're proud to announce that the sensational new LUXURAY Bed Lamp uses a distinctive housing of PLASKON Molded Color, to make this utility item a masterpiece of eye-catching beauty wherever displayed for sale.

In the language used in LUXURAY sales-promotion literature: "LUXURAY'S modern styling in soft ivory makes it an asset to every decorative scheme. It's made of PLASKON Molded Color—easy to keep clean—brings new eye luxury through conditioned light. It's smart . . . it's modern. It harmonizes with the most elaborate or simplest of tastes."

PLASKON Molded Color has become the world's largest-selling urea-formaldehyde plastic because it offers manufacturers so many production and sales advantages.

Do you want color? Plaskon hues are strikingly beautiful, and cover a wide range of warm, glowing tones. Do you want light weight? Plaskon has it, combined with exceptional strength that resists heavy wear. No matter under what conditions Plaskon must serve, it will not chip, corrode, rust or tarnish. And its smooth, hard, non-porous surface cannot be stained or scratched. Plaskon tone values are permanent, because it is solid color through and through.

We shall be glad to give you the benefit of our technical experience in adapting Plaskon Molded Color to your production and sales-promotion needs. Write for a Plaskon representative to call upon you.

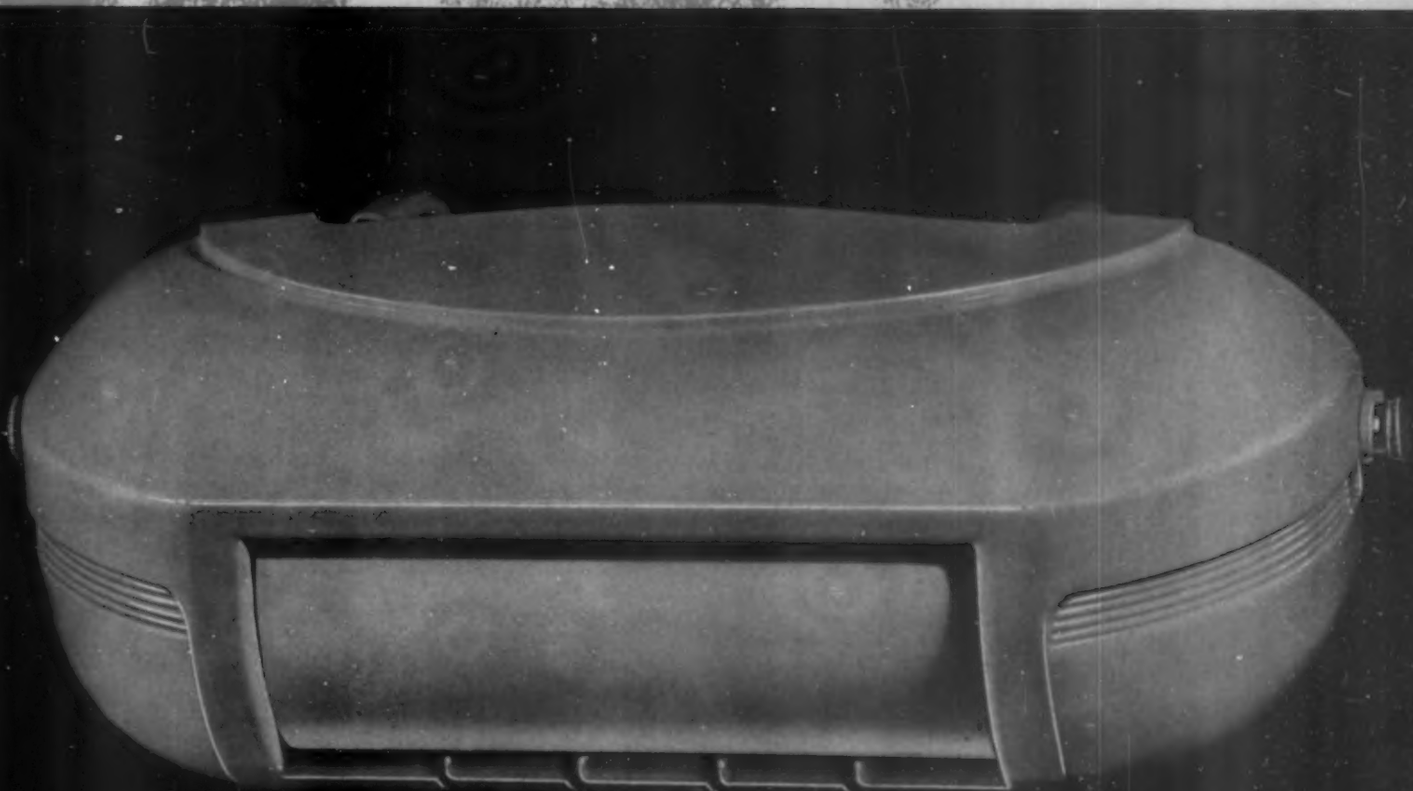
PLASKON COMPANY

Incorporated

2121 SYLVAN AVENUE • TOLEDO, OHIO

Canadian Agent: Canadian Industries, Ltd., Montreal, P.Q.

chosen for *better light bed lamp!*



The Luxuray Bed Lamp is another splendid example of how Plaskon Molded Color is being utilized by the electrical manufacturing field. The Luxuray Bed Lamp is molded for the Mitchell Mfg. Co., Chicago, Ill., by International Molded Plastics, Inc., Cleveland, Ohio. The unit measures 9⅞" in length, 3¾" in width, and 3¾" in depth.

Trade Mark Registered

PLASKON

★ MOLDED COLOR ★

Design for plastic products*

INDUSTRIAL designers are sometimes considered long-haired artists who draw pretty pictures of products which cannot be made. Making a product good-looking is only one of the functions of the industrial designer. Our aim is concentrated upon increasing the salability of an article, which is, in effect, increasing the *desirability*. Actually, desire is the reason behind almost every purchase. There are only two real necessities in this life of ours—*food and shelter*. Every other article is purchased for one reason alone—because it is desired. And even the choice of necessities is based on desire. Ice cream and silk hats are food and clothing, but not exactly essential.

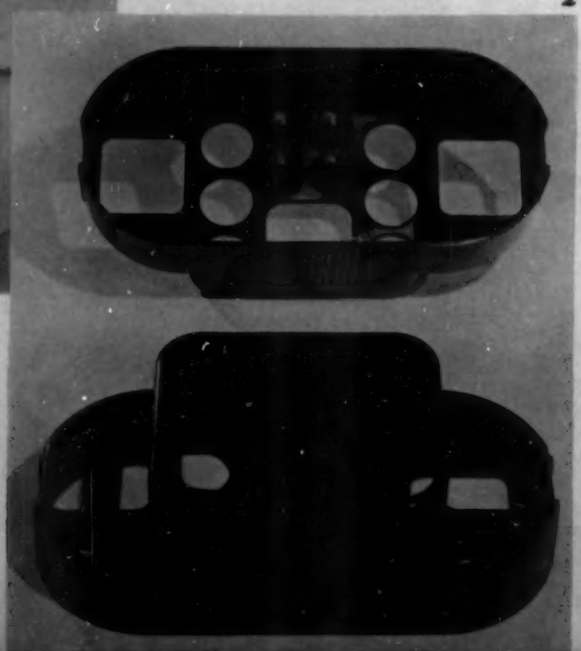
Now, desire may be present in the form of amusement, convenience, comfort, labor saving, protection or simple satisfaction of vanity. The foundation for a solution of a design problem calls for investigating every possible manner of increasing the inherent desirability, and, if possible, adding to it while striving for a reduced production cost. With competition keener than ever, many a manufacturer is finding decreased production cost essential.

For some reason, which I have never been able to understand, most manufacturers, in considering the problem of reducing production costs, turn first to the labor possibilities. There is little margin of savings to be found in that angle today. Usually it is not possible or advisable to decrease wages. Therefore, materials or methods of fabrication offer the greatest opportunities for lowering manufacturing costs. Plastics often become the solution because no finishing is required. Complicated shapes may be produced in one piece eliminating assembly, and often the one material may serve structurally as an insulator and as an attractive exterior. The materials selected often improve or increase desirability, and in (*Please turn to page 94*)

1

1—Compact and lightweight the Porto-Bar measures 21½ in. long, 9¾ in. wide and 7½ in. high. Weighing less than 5 lbs., the unit is molded of Bakelite phenolic in one part by Chicago Molded Products Company. Handles are molded Tenite. 2—Close-up of interior and exterior shows various wells for decanters and glasses. 3—Another Barnes and Reinecke design is the streamlined bicycle tail light with body molded in two parts of opaque cellulose acetate. Translucent lens is red

2



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* This article is abridged from an address by Jean Otis Reinecke, industrial designer of Barnes & Reinecke, presented at a meeting on "New Developments in Molding Plastics" in the Auditorium of the Museum of Science and Industry, Chicago, Illinois, October 21, 1940, sponsored by the Bakelite Corporation.

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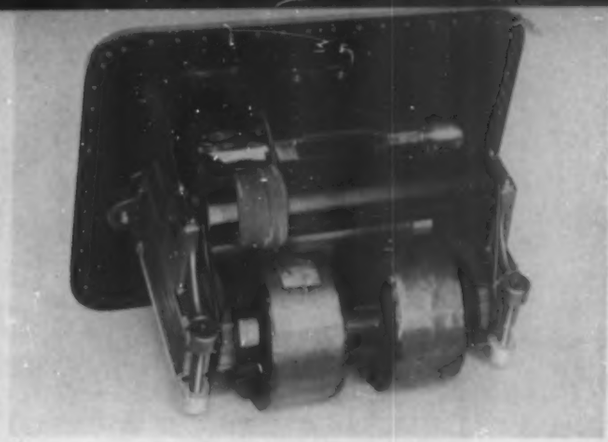

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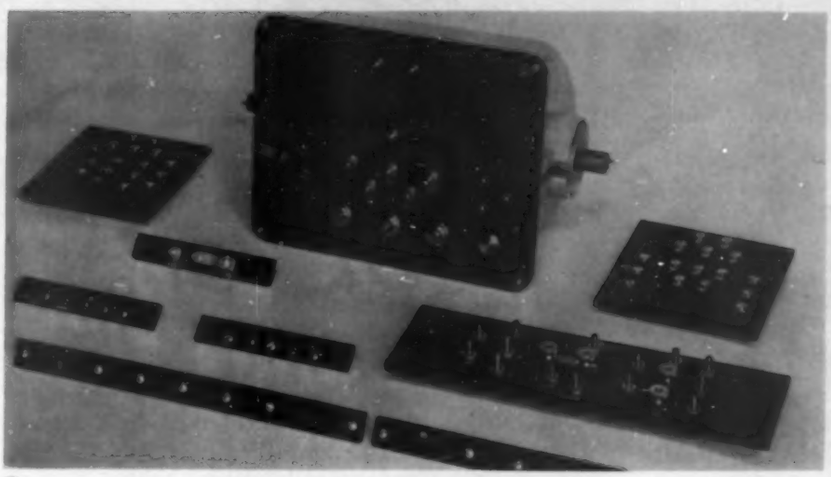


3

4

1—Specially constructed Dilecto laminated, natural on one side and black on the reverse, encloses the X-ray tube and affords protection to the operator. 2—Tube head cover is removed to show laminated tubes beneath. 3—Various terminal strips are produced in black. 4—Laminated plastic short wave diathermy panel by H. G. Fischer Co., combines good appearance with required insulating protection

Phenolic laminated in X-ray equipment

by G. E. LANDT*

X-ray apparatus demands the durability, complete insulation and beauty found in phenolic laminates

THE application of insulating materials to X-ray apparatus places a unique and difficult burden on them. X-ray equipment is largely supplied to the medical profession where considerable emphasis must be placed on appearance. Such equipment is also exposed to unusual conditions of service. A portion of the equipment, particularly the tube containers, must be moved from place to place to permit a wide variety of positions for various applications to X-ray photography as well as X-ray treatment. This necessitates a ruggedness in the construction of all its parts which must apply as well to the insulating materials, especially where such materials serve the additional purpose of supports for the X-ray tubes.

Added to all of these is the peculiar necessity of insulating against the passage of X-rays themselves. These rays will penetrate solid matter and the rate of penetration is proportional to the atomic weight of the substituent elements composing that matter. This behavior provides the mechanism for X-ray examinations, photography, and therapy. The procedure in X-ray photography is to focus X-rays on the affected object and to insulate other portions of the body as well as the attending physicians and nurses from the harmful effects of these radiations.

The problem involved in meeting the mechanical requirements of X-ray equipment as well as that of providing a suitable dielectric is readily met by the phenolic laminates. These, of course, are likewise especially adaptable for decorative purposes and where it is necessary to provide a distinguished appearance in the structural elements of the equipment. The special problem of providing insula- (*Please turn to page 96*)

* Technical Director, Continental Diamond Fibre Co.

Controlling mold closing

by EDWARD S. WALKER*

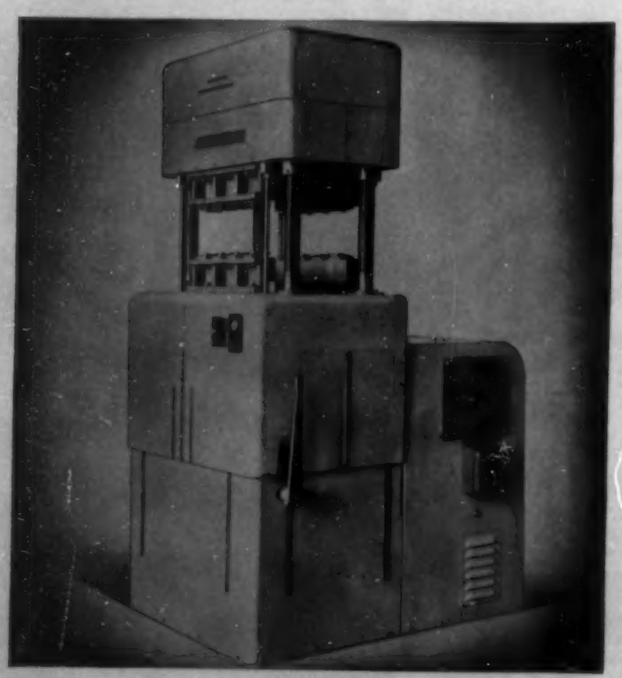
New equipment developments to control closing speeds aid in precision molding

THE speed at which the mold is closed during the stages of compression is a most important factor in molding precision parts or those containing delicate inserts, also in the production of moldings with thick and thin sections and when using molds having thin pins or projections which are susceptible to damage. Controlling the speed during final closing also permits the use of less expensive flash type molds where they would otherwise be impractical. Savings in material on flash type molds often run as high as 20 percent.

While many molders are aware of the advantages obtainable through more precise control of closing speeds, particularly in precision molding, it is only recently that automatic molding presses were made available in which such control is possible. In this type press the closing action is timed automatically and is exactly duplicated in each cycle. The press closes in the clear at high speed to a predetermined point at which pressure starts to build up in the mold. At this stage the closing speed is automatically reduced and can be timed over the remaining distance in from one second to 20 minutes. The adjustments are simple and flexible. They can be set so that the slow closing action starts at any desired point of ram travel and speed of final closing can be adjusted while ram is in motion.

* F. J. Stokes Machine Co.

Standard type toggle-type molding press supplied by F. J. Stokes Machine Co. incorporates the slow-close device and an improved automatic time-cycle control



When molding compound in the form of powder or preforms is loaded into any mold cavity, obviously only the surface area is in actual contact with the hot metal of the die. From the moment of loading until the molds are placed under pressure, a certain amount of preheating occurs—concentrated at the die surface and to a much lesser degree in the inner core. Under conventional molding methods the force or plunger rapidly engages under high pressure, causing the surface material to plasticize almost immediately while there is a delayed action in the cooler inner core. With the rapid build-up of pressure, this plastic surface material follows the path of least resistance, resulting in a surge of material or flash ring in the open space between cavity walls and plunger. This is especially true in flash type molds and must be compensated for by *over-loading* the cavity, otherwise the molding would be of insufficient density and a *short* would occur.

By controlling the speed of closing, instead of rapidly building up high pressure on the granular material, the press is closed rapidly only to a point where moderate pressure develops in the mold. At this point, the closing action is automatically slowed down and the molds close the remaining distance *only as fast as the material plasticizes*. As the material starts to plasticize its density increases and its volume becomes smaller. In the meantime, the press has *crept up* only sufficiently to take up the slack and maintain the initial low pressure as a constant.

In order to build up pressure, there must be resistance—thus the creeping action of the press and reduction in volume of material are kept in balance and the initial pressure is not increased until full plasticity is reached. By maintaining this low constant pressure during the plasticizing period, the tendency for *flash surge* is greatly reduced. Instead of a rush of material, there is now a very gentle flow. When the film of flash reaches the opening between upper and lower die, a sealing action takes place because the material now has an opportunity to *set-up*. Thus, it is possible to charge the cavity with a minimum of material without danger of underloading.

When molds are closed at fairly high speeds with correspondingly rapid build-up (*Please turn to page 92*)

Address all inquiries to Stock Mold Dept., Modern Plastics, Chanin Building, New York

All molders are invited to send samples from stock molds to appear on this page as space permits

Stock Molds

SHEET ONE HUNDRED-TWO

Escutcheons, handwheels, football cleats, bushings, furniture knobs and pulls are available without mold cost from stock molds. Please specify both item and sheet number when requesting manufacturers' names and addresses

---

1204. Rectangular escutcheon, 6 1/2 in. by 2 7/16 in. by 9/16 in. deep. Inside front opening 5 5/16 in. by 1 5/8 in., and 5 1/4 in. by 1 3/8 in. at back

1205. Large handwheel 5 1/4 in. in diameter; 5/8 in. diameter rim. 1/8 in. diameter hub, 7/8 in. long. Brass bushing in center with any size opening. Rim has brass insert for handle tapped 1/4-20

1206. Tapering football cleat, 15/16 in. high. Base 1 in. in diameter with 3/16 in. brass thread. 11/32 in. diameter top

1207. Football cleat, 7/8 in. high; 15/32 in. diameter top. 1 in. diameter base with 3/16 brass thread

1208. Football cleat, 1 1/8 in. high; 11/32i n. diameter top. 1 in. diameter base with 5/16 in. screw

1209. Football cleat, 1 1/8 in. high; 11/32 in. diameter top. 1 in. diameter base with 3/16 in. inse·t

1210. Knob with winged figure design molded on top and fluted sides. Overall diameter 1 in. Height 5/8 in. 5/16 in. opening at base

1211. Knob, same as 1210, but 1 1/4 in. in diameter

1212. Molded bushing, 1/8 in. pipe thread. 5/8 in. high; 5/16 in. diameter through center. 5/8 in. overall top diameter

1213. Molded bushing 1/4 in. pipe thread. 5/16 in. diameter through center. 11/16 in. overall top diamet r. 7/16 in. high

1214. Molded bushing, 3/8 in. pipe thread. 7/16 in. diameter through center. 3/4 in. overall top diameter. 3/8 in. high

1215. Decorative radio knob 7/8 in. high. Overall top diameter 1 3/8 in. Base, 13/16 in. in diameter with 1/4 in. opening. 1/8 in. metal screw on side

1216. Decorative furniture knob 7/8 in. high. 1 3/8 in. top diameter. Base 13/16 in. in diameter with 1 1/8 in. long metal thread

1217. Decorative furniture knob, same as 1216, but in white

1218. Venetian blind pulls, 1 1/8 in. high. 5/8 in. overall diameter of base with 3/16 in. opening at top and 7/16 in. opening at bottom

RESINS WITH A RECORD ...for finishes with a future

ALUMINUM PAINT for city truck fleet maintenance must show great wear and weather resistance—and it does when formulated with Durez resins!

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DUREZ RESINS have long enjoyed an enviable record in the automotive industry for producing black fender dipping enamels that really can "take it."

DUREZ RESINS are used with great success and economy in shop coats for steel work. These finishes also have many outdoor metal applications.

SHOWN HERE are some of the applications of industrial finishes made with Durez 100% phenolic resins. They represent but a handful of the many types of industrial paints and primers that are being made tougher and more durable—and often at lower cost—with Durez oil soluble resins. The list is "as long as your arm"—and growing all the time!

No matter what kind of industrial surface protection is wanted, you'll find that formulations made with one or more Durez resins will give your product the desired qualities—with something to spare! And you'll also find exactly the *type* of Durez resin you need to impart these qualities. Write for information and suggestions.

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DUREZ PLASTICS & CHEMICALS, INC.

PLASTICS THAT FIT THE JOB

Phenolic-asbestos plant equipment*

by WM. H. ADAMS, JR.**

THE phenolic resins and, in particular, asbestos-filled phenolic resin compositions have presented the designers of equipment for handling corrosive chemicals with an important new tool. A great many engineers are, however, relatively unfamiliar with the designs required for this type of material. Since very little has been published on this subject, the tendency has been to employ principles which would be applicable to metals, but which are not necessarily applicable to a plastic. It is the purpose of this paper, therefore, to develop the basic design principles which years of experience have indicated are most satisfactory and to show how these principles are applied to actual commercial corrosion-resistant equipment.

The phenolic resins have long been known to possess exceptionally good resistance to corrosion, especially to acids. In the early days of the industry, however, application of the phenolic resins to corrosion problems was very limited. First of all, the process of molding restricted the user either to simple shapes, like sheets, rods and tubes, or to small molded articles which could be produced in multiple cavity molds under heat and pressure. Secondly, most of the early compositions used as fillers were wood-flour, cotton or some other form of cellulose. When used with acids, there was a tendency for penetration and consequent destruction of the filler.

The development of full-size commercial equipment awaited the discovery of a new molding technic. In general, it consists in the loading of a putty-like composition into simple inexpensive molds. While the process has no exact analogy, it can be likened to the formation of cement or concrete parts. The process eliminates completely the use of hydraulic presses and cumbersome hardened steel molds, which would be required to resist the heavy hydraulic pressure. By eliminating both the hydraulic press and the hydraulic pressure, numerous economies are at once realized, which make it possible to produce economically even very large equipment, such as cylindrical tanks 9 ft. in diameter. Such a process could obviously be applied to compositions containing cellulose as a filler. They would not, however, have the necessary chemical resistance for severe corrosion. Consequently, development work was necessary towards the use of other fillers. Asbestos was finally selected for this purpose, because, being fibrous, it provides the mass with considerable strength. The more common varieties of asbestos are not, however, sufficiently acid-resistant, and it is necessary to use a particular type. Even this special asbestos must be digested in acid to remove a small soluble portion.

These two developments taken together permitted the application of so-called Haveg to industrial corrosion-resistant equipment. Haveg[1] has been used for this purpose for many years, having been first constructed in the United States in 1932 and for ten years prior to that in Europe.

General Design Considerations

First of all, there is the question of chemical resistance. There are three grades of the material available. The first grade, and the most commonly used, is the so-called Haveg "41." This is resistant to practically all inorganic acids except oxidizing agents like nitric and concentrated sulphuric acid. It is resistant to most salts, to some of the weaker bases, to chlorine, and to many solvents. It is not resistant to oxidizing agents, strong bases like sodium hydroxide, nor to acetone or similar solvents. The second grade is Haveg "43." This material, which uses a carbonaceous filler in place of the asbestos, is resistant to hydrofluoric acid, and while it is also resistant to other acids, its use is almost always restricted to fluorine compounds. Haveg "50" is a recently developed grade which is primarily resistant to the strong bases like sodium and potassium hydroxide, and also has resistance to most inorganic acids comparable to that of Haveg "41." It can, therefore, be used in process equipment which may be either acid or basic.

Next, there is the question of temperature. All standard grades of the phenolic-asbestos material are resistant physically and chemically, up to a temperature of about 265 deg. F. If temperatures are within this range, the application is satisfactory from the

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* Presented before the Rubber and Plastics subdivision of the Process Industries Division of the American Society of Mechanical Engineers at the Annual Meeting, New York, Dec. 5, 1940.

** Haveg Corp.

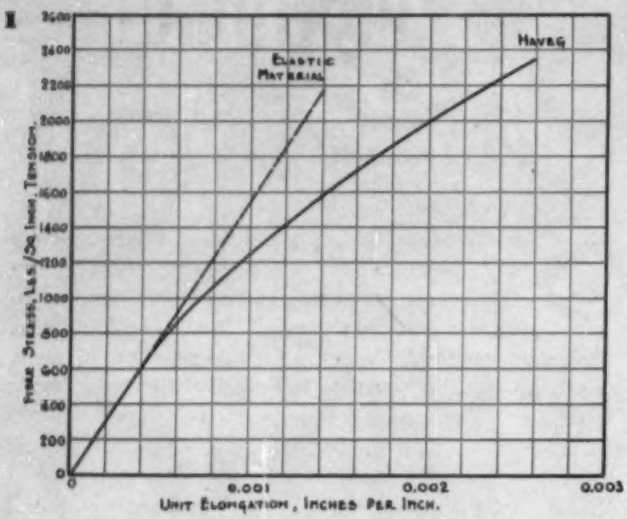
[1] Trade name of the Haveg Corp.

temperature standpoint. Above 265 deg., the application is usually doubtful and must be tested before adoption. The material is not subject to damage from thermal shock, so no particular attention has to be given to the rapidity of temperature changes.

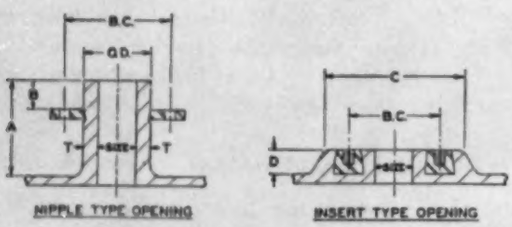
The phenolic-asbestos material is supplied in the form of cylindrical, rectangular and odd shaped tanks, pipe, valves and fittings, fume duct, fan housings, pumps, drying trays, crystallizers, agitators, textile agers, absorption towers, sheets and many items not so easily classified which are generally of cylindrical or rectangular shape. There is no serious limitation as to the shape of equipment which can be produced. Irregular and complicated items can be and, in fact, are being regularly produced, such as cone bottom and round bottom tanks and tanks containing baffles or cells. There are limitations in size, however. For instance, in considering pipe or cylindrical tanks, the largest available diameter is 9 ft. The maximum depth depends on the diameter, and is generally about 10–12 ft. The limitation in length is not particularly important because where deeper tanks are required, it is a simple matter to bolt together a number of smaller sections. With rectangular tanks, the same conditions apply. Seamless one piece tanks are restricted to about 10–12 ft. in length, but tanks up to even 90 ft. long are produced by bolting together flanged sections. Such tanks are often required, especially for some of the more modern continuous strip-pickling processes.

Finally, the physical nature of the application must be considered. The phenolic-asbestos material is most generally used in stationary equipment. It is not usually satisfactory for moving parts, especially if these are large. There are exceptions to this in the application of the material to pump impellers, agitators and tumbling barrels, but most applications do not involve motion. It can stand shocks or blows remarkably well, but there are limits, of course, and such equipment should not be subjected to abusive shock conditions, such as would be encountered, for instance, by dropping a load of steel into a pickling tank. The resistance of the material to abrasion is fairly good and it is actually used for wear plates in certain wire-pickling processes. Scratches and gouges need cause no concern because the phenolic-asbestos material is not a lining but a solid material whose corrosion resistance exists throughout the entire mass. Nevertheless, it will not resist for long the grinding action of sand particles, nor the impingement of a direct high-velocity steam jet.

1



2



Size	NIPPLE TYPE							INSERT TYPE*				
	O.D.	T	A	B	B.C.	BOLTS No.	BOLTS Size	C	D	B.C.	BOLTS No.	BOLTS Size
½	1 5/16	1/4	3	1	2 1/16	4	1/4	3 1/16	1/4	2 1/16	4	1/4
¾	1 5/8	1/4	3	1	2 7/16	4	1/4	4 1/16	5/16	2 7/16	4	1/4
1	2	1/4	4	1 1/4	3 1/16	4	1/4	5 1/16	1	3 1/16	4	1/4
1 1/4	2 3/8	1/4	4	1 1/4	3 7/16	4	1/4	5 1/16	1	3 7/16	4	1/4
1 1/2	3	1/4	5	1 1/2	4 5/16	4	1/4	6 1/16	1	3 7/16	4	1/4
2	3 1/2	1/4	5	1 1/2	4 7/16	4	1/4	7 1/16	1 1/4	4 5/16	4	1/4
2 1/2	4 1/16	1/4	6	1 1/2	6	4	1/4	8	1 1/4	6 1/16	4	1/4
3	4 5/8	1/4	6	1 1/2	7	4	1/4	8 1/16	1 1/4	6	4	1/4
3 1/2	5 1/16	1/4	6	1 1/2	7 1/16	4	1/4	9 1/16	1 1/4	7	4	1/4
4	5 5/8	1/4	6	1 1/2	7 1/16	4	1/4	10	1 1/4	7 1/16	4	1/4
6	6 13/16	1/4	6	1 1/2	8 1/16	4	1/4	11 1/16	1 1/4	8 1/16	4	1/4
8	7 3/4	1/4	6	1 1/2	9 1/16	4	1/4	12 1/16	1 1/4	9 1/16	4	1/4
8	10	1	6	2	11 5/16	4	1/4	14 5/16	1 1/4	11 5/16	4	1/4
10	12	1	7	2	14 1/4	6	1/4	18	1 1/4	14 1/4	6	1/4
12	14	1	7	2	17	6	1/4	20 5/8	1 1/4	17	6	1/4

* Inserts are rings of acid-resisting bronze. Other materials will be furnished upon request.

1—Typical stress-strain diagram for Haveg "41". 2—Method of making pipe connections to the equipment

Specific Designs

In regard to physical strength, the following figures for Haveg "41" represent a fairly good average.

Tensile strength	— 2500 lb. per sq. in.
Compressive strength	—10000 lb. per sq. in.
Flexural strength	— 5000 lb. per sq. in.
Shearing strength	— 3500 lb. per sq. in.

With metals, the use of such short-time strength values as this in the usual design formulae with normal safety factors would be the accepted practice. With phenolic-asbestos material, such a procedure would be not only bad practice, but might actually lead to an incorrect result. The clue to this is found in the fact that the material has many of the properties of a plastic. A true plastic would be permanently deformed by any load, no matter how slight. A truly elastic material, on the other hand, would return to the original dimensions, meaning that the stress-strain diagram is a straight line. Phenolic-asbestos composition is somewhere between these in its behavior. Its stress-strain diagram (Fig. 1) is usually a straight line under only

SIZE	O.D.	WALL & BOTTOM THICKNESS								BANDS, STAVES, & HOOPS																
		HEIGHT		HEIGHT		HEIGHT		HEIGHT		SIZE		NO.	HEIGHT OF TANK IN FEET													
		W. T.	B.T.	W.T.	B.T	W.T.	B.T.	W.T.	B.T.	BANDS	HOOPS	STAVES	1	2	3	4	5	6	7	8	9	10	11	12	13	14
10"	11"	0 TO 13'											TANKS WITHIN THIS AREA ORDINARILY DO NOT REQUIRE BANDS, STAVES, OR HOOPS													
		1/2"	5/8"																							
11"	12"	0 TO 11'-2"		11'-2" TO 13'-0"																						
		1/2"	5/8"	5/8"	3/4"																					
12"	13½"	0 TO 10'-6"		10'-6" TO 13'-0"																						
		1/2"	5/8"	5/8"	3/4"																					
13"	14¼"	0 TO 9'-10"		9'-10" TO 13'-0"																						
		1/2"	5/8"	5/8"	3/4"																					
14"	15½"	0 TO 8'-10"		8'-10" TO 13'-0																						
		1/2"	5/8"	5/8"	3/4"																					
15"	16¼"	0 TO 8'-2"		8'-2" TO 13'-0																						
		1/2"	5/8"	5/8"	3/4"																					
16"	17½"	0 TO 7'-7"		7'-7" TO 13'0																						
		1/2"	5/8"	5/8"	3/4"																					
18"	19¼"	0 TO 6'-7"		6'-7" TO 13'-0"						1/8"x1 1/2"																
		1/2"	5/8"	5/8"	3/4"																					
19"	20"	0 TO 6'-3"		6'-3" TO 13'0"						1/8"x1 1/2"																
		1/2"	5/8"	5/8"	3/4"																					
20"	21½"	0 TO 5'-11"		5'-11" TO 13'0"						1/8"x1 1/2"																
		1/2"	5/8"	5/8"	3/4"																					
2'	2'-1¼"	0 TO 4'-7"		4'-7" TO 13'0"						1/8"x1 1/2"																
		1/2"	5/8"	5/8"	3/4"																					
2'-6"	2'-7½"	0 TO 3'-5"		3'-5" TO 10'-6"		10'-6" TO 12'-6"				1/8"x1 3/4"																
		1/2"	5/8"	5/8"	3/4"	3/4"	1"																			
3'	3'-1¼"	0 TO 2'-4"		2'-4" TO 8'-7"		8'-7" TO 12'-6"				1/8x1 3/4"																
		1/2"	5/8"	5/8"	3/4"	3/4"	1"																			
3'-6"	3'-7½"	0 TO 1'-11"		1'-11" TO 7'-3"		7'-3" TO 12'-0"				1/8"x1 3/4"	5/8"	23	TANKS WITHIN THIS AREA REQUIRE STAVES & HOOPS													
		1/2"	5/8"	5/8"	3/4"	3/4"	1"																			
4'	4'-1½"	0 TO 6'-2"		6'-2" TO 12'-0"						3/16"x 2"	5/8"	26														
		5/8"	3/4"	3/4"	1"																					
5'	5'-1½"	0 TO 4'-7"		4'-7" TO 9'-5"		9'-5" TO 11'-6"				3/16"x 2"	5/8"	32														
		5/8"	3/4"	3/4"	1"	1"	1 1/4"																			
6'	6'-2"	0 TO 3'-6"		3'-6" TO 7'-8"		7'-8" TO 11'-0"				3/16"x 2"	5/8"	38														
		5/8"	3/4"	3/4"	1"	1"	1 1/4"																			
7'	7'-2⅜"	0 TO 2'-10"		2'-10" TO 6'-4"		6'-4" TO 10'-6"				3/16"x 2 1/2"	3/4"	45														
		5/8"	3/4"	3/4"	1"	1"	1 1/4"																			
8'	8'-2⅜"	0 TO 2'-3"		2'-3" TO 5'-3"		5'-3" TO 8'-10"		8'-10" TO 10'-0"		3/16"x 2 1/2"	3/4"	50														
		5/8"	3/4"	3/4"	1"	1"	1 1/4"	1 1/4"	1 3/8"																	
9'	9'-2⅜"	0 TO 1'-10"		1'-10" TO 4'-6"		4'-6 TO 7'-9"		7'-9" TO 9'-0"		3/16"x 2 1/2"	3/4"	58														
		5/8"	3/4"	3/4"	1"	1"	1 1/4"	1 1/4"	1 3/8"																	

3—*Design data for standard cylindrical Haveg tanks for atmospheric pressure*

light loadings, becoming definitely curved as the loading increases towards the point of failure. Translated into terms of operation, this means that the material may be permanently deformed under loading conditions well within the safe limits, which would have been predicted from the short-time ultimate strength figures given above. This tendency is noticeable at room temperature and becomes marked at the maximum of 265 deg. F. It is similar to the phenomenon of "creep" in steel operated at high temperatures. Actual data on the allowable loads to prevent this permanent deformation are very meager and as yet are not reliable enough for practical use. In practice, the condition is met by applying external steel or wood reënforcements except where loading conditions are well within the proportional limit.

Wall thicknesses in tanks and similar items are, therefore, determined more by the necessities and conveniences of the molding operation than they are by the ultimate strengths. For instance, the thinnest wall that is practical is $^1/_4$ in., and the maximum is about $2^1/_2$ in. Wall thicknesses practically always fall within this range. The molding process also presents other limitations. For instance, sharp angles are to be avoided when possible; but where they are essential, as, for instance, between the walls and bottom of a tank, an adequate fillet should be provided. Similarly, sharp changes in wall thicknesses are bad practice. It would not be recommended, for instance, to mold together a tank wall $1^1/_2$ in. thick with a $^1/_8$-in. baffle.

(*Please turn to next page*)

***4**—Cylindrical tanks of 5 ft. dia. equipped with covers and supported by means of steel bands.* ***5**—Installation of Haveg tanks 9 ft. diameter by 5 ft. deep, shows support consisting of wood staves and steel hoops*

4

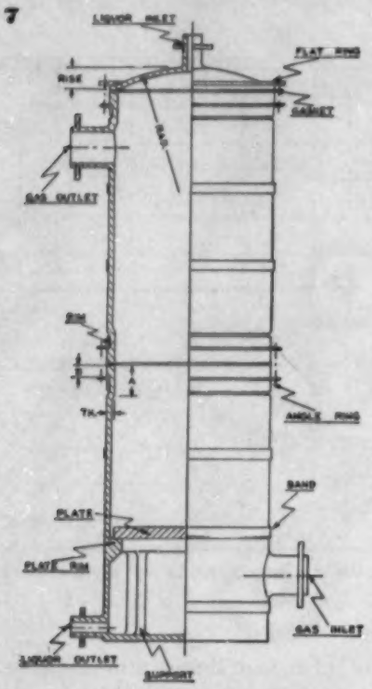
5

6—*Method of fabricating and attaching dished covers to tanks*

Outlets, pipe connections and other openings in tanks can be provided almost at will, but the types which are recommended consist of molded-in nipples or bosses containing inserts for bolting (Fig. 2). Pipe threads are almost never recommended.

Completely hollow articles cannot be produced, but articles which have only one opening can be produced. In the case of a cylindrical tank, for instance, both heads can be molded integrally with the wall provided a manhole is included. Complicated internal designs, such as baffles, cells and coil supports, offer no particularly serious problem and are regularly supplied. Obviously, however, the greatest permissible simplicity should be retained in the best interests of economy.

7



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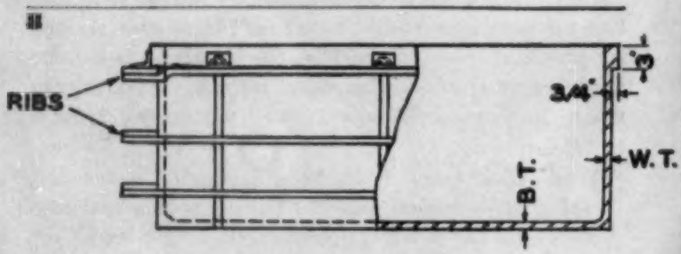
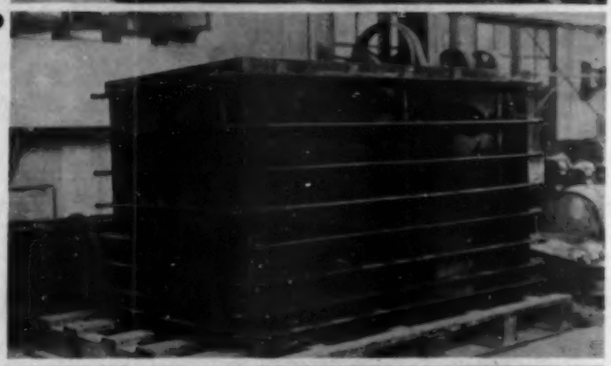


Depth of Tank	WALL & BOTTOM THICKNESS						LENGTH		
	Length		Length		Length		No. of Ribs	No. of Ribs	No. of Ribs
	W.T.	B.T.	W.T.	B.T.	W.T.	B.T.			
6"	0 to Max.	½"	⅜"				0 to Max.	0	
1'-0"	0 to Max.	½"	⅜"				0 to Max.	0	
1'-6"	0 to 8'-2"	½"	⅜"	8'-2" to Max.	⅜"	¼"	0 to 2'-6"	0	2'-6" to Max. 3
2'-0"	0 to 2'-4"	½"	⅜"	2'-4" to Max.	⅜"	¼"	0 to 1'-6"	0	1'-6" to Max. 3
2'-6"	0 to 1'-8"	½"	⅜"	1'-8" to Max.	⅜"	¼"	0 to 1'-6"	0	1'-6" to Max. 3
3'-0"	0 to 1'-4"	½"	⅜"	1'-4" to Max.	⅜"	¼"	0 to 1'-3"	0	1'-3" to 5'-0" 3 / 5'-0" to Max. 4
3'-6"	0 to 1'-0"	½"	⅜"	1'-0" to 8'-2"	⅜"	¼"	0 to 2'-3"	0	2'-3" to 7'-0" 4 / 7'-0" to Max. 5
4'-0"	0 to 6'-8"	⅝"	¼"	6'-8" to 8'-2"	¼"	⅜"	0 to 1'-3"	0	1'-3" to 7'-6" 5 / 7'-6" to Max. 6
4'-6"	0 to 5'-0"	⅝"	¼"	5'-0" to Max.	¼"	⅜"	0 to 1'-0"	0	1'-0" to 7'-6" 6 / 7'-6" to Max. 7
5'-0"	0 to 4'-0"	⅝"	¼"	4'-0" to 8'-3"	¼"	⅜"	0 to 1'-0"	0	1'-0" to 7'-6" 7 / 7'-6" to Max. 8
5'-6"	0 to 3'-6"	⅝"	¼"	3'-6" to 4'-2"	¼"	⅜"	0 to 1'-0"	0	1'-0" to 7'-6" 8 / 7'-6" to Max. 9
6'-0"	0 to 3'-2"	⅝"	¼"	3'-2" to 3'-9"	¼"	⅜"	0 to 1'-0"	0	1'-0" to 5'-6" 9 / 5'-6" to Max. 10
6'-6"	0 to 2'-11"	⅝"	¼"	2'-11" to 3'-4"	¼"	⅜"	0 to 1'-0"	0	

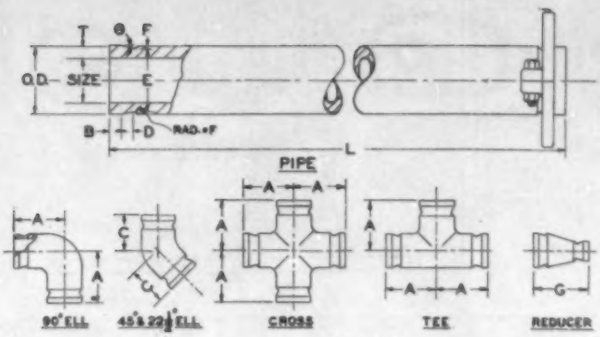
9

10



11

7—Design principles of Haveg absorption tower, built in sections. 8—Design data for rectangular tanks. 9—Small one piece rectangular pickling tank equipped with three steel support ribs. 10—Large deep rectangular tank which required 8 steel support ribs. 11—Simple flange construction for bolting together sections in a long shallow pickling tank



Design Data and Dimensions

Size	O.D.	T	PIPE						FITTINGS		REDUCERS				FLANGES		
			B	D	E	F	θ	L	A	C	Size	G	Size	G	Bolt Circle	Bolts No.	Bolts Size*
½	1¼	⅜	⅜	¼	1⅛	⅛	14°	4′	2⅛	1¾	¾× ½	4	4×2	7	2⅜	4	¼×1¾
¾	1⅝	⅜	½	¼	1⅝	⅛	14°	4′	2¾	2	1 × ¾	4	4×2½	7	2⅞	4	¼×2
1	1¾	⅜	½	⅜	1⅞	⅛	9½°	10′	3⅛	2⅛	1¼×1	5	4×3	7	3⅛	4	¼×2½
1¼	2	⅜	½	⅜	1⅞	⅛	9½°	10′	3¾	2⅛	1½×1	5	5×3	8	3½	4	¼×2½
1½	2⅜	½	½	⅜	2⅜	⅛	8°	10′	4	2¾	2 ×1	5	6×4	8	3½	4	¼×2¾
2	3	½	½	½	2⅞	⅛	7°	10′	4½	3¼	2 ×1½	5	6×3	9	4¾	4	⅜×3
2½	3⅝	½	½	½	3⅝	⅛	7°	10′	5	3¾	2½×1	5	6×3	9	5½	4	⅜×3
3	4⅛	⅝	⅝	⅝	4⅛	⅛	9½°	10′	5½	3¾	2½×1½	5	6×4	9	6	4	⅜×3¼
3½	4⅝	⅝	⅝	⅝	4⅝	⅛	9½°	10′	6	4	2½×2	5	8×4	11	7	4	⅜×3¼
4	5¼	⅝	⅝	⅝	4⅝	⅛	14°	10′	6½	4¼	3 ×1	6	8×6	11	7½	4	⅜×3½
5	6⅜	¾	¾	⅝	6⅛	⅛	14°	10′	7½	4½	3 ×2	6	10×4	12	8½	4	⅜×3¾
6	7½	¾	¾	⅝	7⅛	⅛	14°	10′	8	5	3½×1	6	10×6	12	9½	4	⅜×3¾
8	9¾	⅞	⅞	¾	9⅛	⅛	14°	10′	9	5½	3½×2	6	10×8	12	11¾	4	⅜×4¼
10	12	1	1	¾	11⅝	⅛	14°	10′	11	6½	4 ×1	7	12×6	14	14¼	6	⅜×4¾
12	14	1	1	⅞	13⅝	⅛	14°	10′	12	7½	4 ×1½	7	12×8	14	17	6	⅜×5

* Bolt holes are cored ⅛″ larger than bolt diameters.
Fitting dimensions are same as pipe dimensions.
The actual O.D. of pipe and fittings will vary ⅛″ to ¼″.
All flanges have A.S.M.E. bolt circle.

12—*Design data on standard Haveg pipe and fittings*

These design principles can best be illustrated by reference to a few typical examples.

Cylindrical tanks

Any diameter of tank can be produced up to the 9-ft. maximum. However, standards have been established ranging up from 10 in. diameter, and it is so much more economical to employ them that they are almost universally used. Figure 3 gives the design data for these standard cylindrical tanks, including external supports where these are needed. It will be noted that wall thicknesses range from ½ in. in the smallest size up to 1¼ in. for the largest. It will also be noted that the smallest sizes require no external support, which means that stresses are well within the proportional limit. Intermediate sizes require some support, which is provided by the use of simple steel bands, while the largest sizes are equipped with vertical wood staves together with steel hoops.

In the case of cylindrical tanks, the fixed parts of the mold are outside of the phenolic-asbestos material. The outside diameter of all such tanks of a given diameter is, therefore, the same, regardless of the wall thickness. The inside diameter obviously varies with the wall thickness.

Example 1.—Tank 12 in. diameter by 12 in. deep. From the table, wall thickness = ½ in., bottom thickness = ⅝ in. Outside diameter = 13½ in. Inside diameter = 12½ in. No supports required.

Example 2.—Tank 3 ft. diameter by 9 ft. deep. From the table, wall thickness = ¾ in., bottom thickness = 1 in. Outside diameter = 3 ft. 1¼ in. Inside diameter = 2 ft. 11¾ in. Tank will be supported by 9 steel bands, ⅛ in. by 1¾ in., about 12 in. apart. A tank of this type is illustrated in Fig. 4, page 55.

Example 3.—Tank 9 ft. diameter by 9 ft. deep. From the table, wall thickness = 1¼ in., bottom thickness = 1⅜ in. Outside diameter = 9 ft. 2⅜ in. Inside diameter = 8 ft. 11⅞ in. Support consists of 58 vertical wood staves, 1½ in. by 3 in., evenly spaced around the circumference and held by means of 9 steel hoops, ⅝ in. in diameter. The design of this type tank is shown in Fig. 5, page 55.

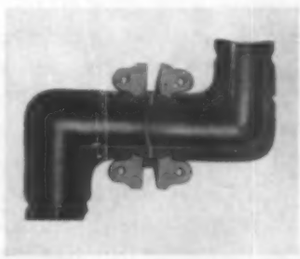
Cylindrical tanks can be equipped with flat or dished covers (Figs. 4–6) with outlets (Fig. 2), sight glasses and other accessories. Horizontal tanks are less common, but can be produced if desired. Phenolic-asbestos composition tanks have been built to withstand pressure up to 15 lb. per sq. in., but are not recommended much above this. Vacuum tanks, up to 4 ft. diameter, have been produced, reënforcing the wall internally by means of molded-in ribs.

Towers

Absorption and scrubbing towers, such as used by the chemical industry, are essentially very deep cylindrical tanks. The design is basically the same as for cylindrical tanks, but usually it is necessary to use two or more sections, bolted together at the joints by means of split steel angle rings set in slots. A perforated plate is usually included to retain the packing, as well as inlet and outlet connections for gas and liquor. Fig. 7 (opposite page) is a typical design.

Rectangular tanks

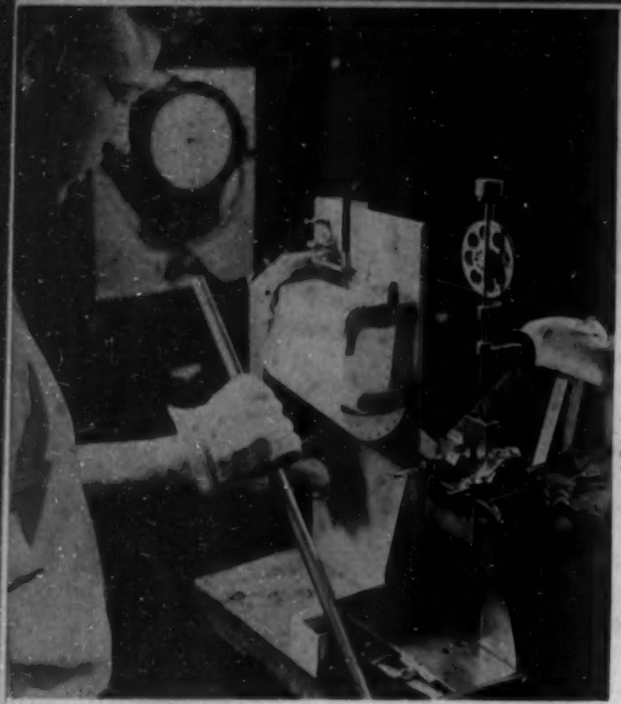
As in the case of cylindrical tanks, practically any



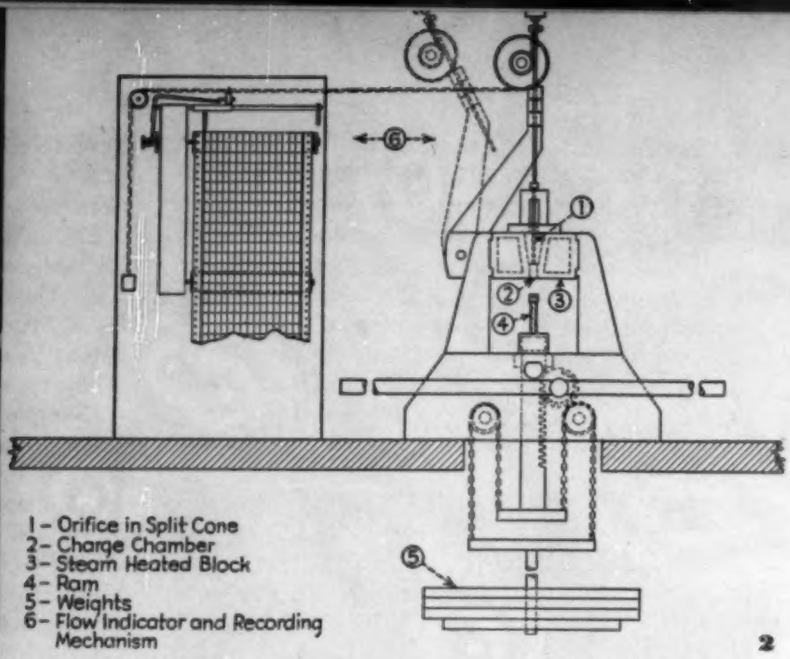
13—*Method of connecting pipe by means of a split flange*

size rectangular tank can be produced within the maximum. Again, however, the use of standard sizes results in considerable economy. In the case of rectangular tanks, standardization is achieved by the use of a mold, the exterior parts of which are built in inter-

(*Please turn to page 80*)



1 PHOTO, COURTESY BAKELITE CORP.



2

1—*The Rossi-Peakes flow tester is shown in operation.* **2**—*Diagrammatic sketch of apparatus identifies various parts*

A.S.T.M. method for flow temperatures

THE complete text of the Tentative Method of Test for "Measuring Flow Temperatures of Thermoplastic Molding Materials," D 569 – 40 T, adopted by the American Society for Testing Materials at its 1940 annual meeting, is published here by permission of the Society.

Scope

1. This method of test determines the temperature at which a thermoplastic material attains a specified degree of flow when subjected to a prescribed pressure in a specified extrusion mold for a definite time. Measurements of flow are made at three or more temperatures, and the temperature for the specified flow is obtained by graphic interpolation. The equilibrium state of the material in this test may not be exactly representative of the state in commercial use.

Apparatus

2. The apparatus for the flow test (see Fig. 1) shall be a constant-force, vertical-orifice type machine[1] consisting essentially of the following:

(*a*) *Orifice.*—A vertical orifice 1/8 in. in diameter and 1 1/2 in. in length (Fig. 2,) *1*, into which the material flows. The orifice is machined into a split cone 1 in. in diameter at the base which is clamped into a steam-heated block, *3*. A thermometer well 3/16 in. in diameter and 1 1/4 in. in depth is drilled into the split cone. Temperature readings are taken at this point.

(*b*) *Thermometer.*—A 1 1/4-in. immersion mercury thermometer having a diameter just under 3/16 in. and a temperature scale of not more than 20 degrees C. per inch of length.

(*c*) *Charge Chamber.*—Below the orifice and concentric with it is the charge chamber, *2*, 3/8 in. in diameter and 3/4 in. in length.

(*d*) *Block.*—A steam-heated block, *3*. Heat is supplied by steam at a line pressure of 90 to 150 psi., passing through an accurate reducing valve; if the line pressure fluctuates too widely, two reducing valves in series may be used. The temperature is controlled by regulating the steam pressure.

(*e*) *Ram.*—A steam-heated ram, *4*, so arranged that it applies pressure to the charge chamber from the bottom, forcing the material into the orifice. The steam line is so arranged that the steam passes through the reducing valve, the ram, the block, and finally through a suitable trap or small vent.

(*f*) *Pressure System.*—A mechanical system, *5*, for applying a net pressure of 1500 psi. to the ram. The pressure system illustrated in Fig. 1 is built so that any pressure up to 3000 psi. may be applied in increments of 100 psi.

(*g*) *Flow Measuring Device.*—Means for measuring the flow of material into the orifice. Measurements shall be accurate to plus or minus 0.01 in. The following measuring systems are suitable:

(*1*) A follower rod, guided (*Please turn to page 92*)

[1] Rossi-Peakes flow tester as described in U. S. Patent 2,066,016.

Flow temperature of thermoplastics

by L. W. A. MEYER*

This paper provides a background and describes some of the work leading up to the A.S.T.M. Tentative Method of Test for Measuring Flow Temperatures of Thermoplastic Molding Materials which appears on the page opposite. These two items are reprinted here through the courtesy of the American Society for Testing Materials.

ONE of the most important properties of thermoplastic molding materials from the manufacturers' and molders' viewpoints is the temperature at which the plastic is soft enough to tolerate mechanical mixing or forced flow into all parts of any given mold. Many devices have been proposed to determine this flow temperature.

The problem of setting up a standard test method which is not too involved, yet yields reliable and usable data, is complicated by the facts that there are many types of thermoplastic materials and that the flow temperatures extend over a wide range. This situation can be successfully met by setting all conditions affecting the softness of a plastic, except the temperature, constant and then varying the temperature until a defined consistency of flowability is reached. Such a means of approach in which cellulose acetate plastics were tested with a Rossi-Peakes flow tester has been previously described.[1]

The results showed sufficient promise as a practical test method to warrant the testing of a number of plastics in several available flow-measuring devices and a program was arranged by Subcommittee III, Section D on Flow Temperature of Thermoplastic Materials, of the A.S.T.M. Committee D-20 on Plastics.

The following types of molding materials were tested: acrylate, polystyrene, vinyl co-polymer, cellulose ether, cellulose acetate. The flow-measuring devices utilized in running the tests were: Rossi-Peakes Flow Tester, Mooney Shearing-Disk Plastometer, Dillon Extrusion Plastometer (modified), Williams Parallel Plate Plastometer (modified).

The Rossi-Peakes flow tester[2] is an extrusion type plastometer. Materials being tested are extruded into an orifice 1/8 in. in diameter and 1 1/2 in. long from a charge chamber 3/8 in. in diameter and 3/4 in. long, which is below and concentric with the orifice. Pressures up to 3000 psi. in steps of 100 psi. are applied mechanically from the bottom by a steam-heated ram. The orifice is machined into a split cone which is clamped into a steam-heated block. All temperature readings are taken by a thermometer well drilled 1 1/4 in. deep into the split cone. Means are provided for regulating and measuring the temperature and for recording the flow of materials in relation to time from the beginning to the end of the test. In the tests, dry specimens 3/8 in. in diameter and 3/8 in. high were used. The specimens at room temperature were inserted into the hot charge chamber and a pressure of 1500 psi. applied immediately. After 2 min., the amount of flow in inches was noted. Each material was run over a temperature range and the temperature at which the material flows exactly 1 in. into the orifice was determined graphically. This was reported as the "flow-temperature."

The Mooney plastometer[3] measures the "shearing viscosity" of thermoplastic materials. Specimens are sheared between a rotating corrugated disk (rotor) 1.5 in. in diameter and 0.218 in. thick, and a corrugated mold (stator) 2 in. in diameter and 0.418 in. deep, surrounding the rotor. The mold is made in two sections, each being provided for heating to any desired temperature and so designed that when closed under the action of a powerful lever system the material is automatically cut and molded to proper form. Constant pressure within the mold is maintained with two plungers activated by springs. The shearing viscosity is measured on an arbitrary scale (in units of 0 to 250) depending on the torque resulting when the disk is rotated at a constant rate of 2 r.p.m. in the confined mass of plastic material. In the tests two specimens 2 in. in diameter and 0.2 in. thick, one of which has a 5/8-in. hole in the center to permit the spindle of the rotor to pass through, were used. The dry specimens, after having been preheated at the testing temperature for 4 to 5 min., were placed in the hot mold, one above and one below the rotor, and after 1/2 min. the mold was closed. The mold surfaces had previously been brushed with calcium stearate powder to prevent undue sticking. After from 3 to 5 min. the rotor was started and continued to run until a constant torque reading (shearing viscosity) was obtained. Each material was run over a temperature range and the temperature at which the shearing viscosity is exactly 100 was determined graphically. This temperature was reported as the "relative plasticity."

The modified Dillon extrusion plastometer[4,5] mea-

* Plastics Research and Development Chemist, Tennessee Eastman Corp.

[1] C. H. Penning and L. W. A. Meyer, "Flow Relations of Thermoplastic Materials," Symposium on Plastics, p. 23, Am. Soc. Testing Mats., Philadelphia, Pa. (1938).

[2] U. S. Patent No. 2,066,016.

[3] Melvin Mooney, "A Shearing Disk Plastometer for Unvulcanized Rubber," *Industrial and Engineering Chemistry*, Analytical Edition, Vol. 6, No. 2, p. 147 (1934).

[4] J. H. Dillon and N. Johnston, "The Plastic Properties of Several Types of Unvulcanized Rubber Stocks at High Rates of Shear," *Physics*, Vol. 4, No. 6, p. 225 (1933).

[5] J. H. Dillon, "A Simplified Extrusion Plastometer for Unvulcanized Rubber," *Physics*, Vol. 7, No. 2, p. 73 (1936).

sures the extrusion rate of plastic materials through an orifice 1/16 in. in diameter and 3/16 in. long from a steam-heated charge cylinder 3 1/2 in. long and 3/4 in. in diameter above and concentric with the orifice. The throat of the orifice is conically shaped with an apex of approximately 90 deg. Pressures are applied to the cylinder from the top by a heated ram 1/2 in. in diameter and having a hemispherical end of 1/2 in. radius. The ram travels from the top of the cylinder to within 1/16 in. of the orifice. Means are provided for measuring and regulating the temperature, accurately timing the test period, and weighing the amount of material extruded during this period.

In the tests 22 1/2 cu. cm. (22 1/2 g. × sp. gr.) of the dry material was charged into the cylinder at the desired temperature, and preheated for 10 min. under a pressure of 500 to 700 psi. A pressure of 3025 psi. was then applied continuously until the plunger reached a point of from 1/8 to 1/16 in. less than maximum travel. During this period at the higher pressure the time was accurately determined and the amount of material extruded was weighed to the nearest centigram. The extrusion rate in cubic centimeters per minute was calculated from these data. Each material was run over a temperature range and the temperature at which the extrusion rate is 10 cu. cm. per min. was determined graphically. This was reported as the "extrusion temperature."

The modified Williams parallel plate plastometer[6] measures the rate of deformation of materials between a stationary lower plate large enough so that the compressed specimen does not reach the edge or any obstruction of the plate and a movable circular upper plate having a lower surface area of 1 sq. in. and a thickness sufficient that in no case does a deformed specimen meet a change in diameter or an obstruction. The upper plate is movable through a distance of 0.55 in.—travel is accurately measured with a dial gage—and the machine is equipped with a spacer which allows compression to 0.475 in. A net pressure of 15 psi. is applied to the specimen. A temperature-controlled bath of oil or other appropriate liquid is used as the heating medium. Means are provided for accurately timing any desired deformation as indicated by the distance of travel of the upper plate. In the tests dry specimens 1 1/4 in. in diameter and 1/2 in. thick, with abrasive paper of the same diameter and 0.007-in. thickness placed with abrasive side in contact with the top and bottom surfaces of the specimen, were used. The dial gage was adjusted to zero reading with the two thicknesses of abrasive paper in place and with the full pressure applied. After inserting the specimen and locating the spacer, the full pressure of 15 psi. was applied and the whole device immersed in the bath at the desired temperature. After 10 min., during which time temperature equilibrium had been reached and the specimen had been compressed to a thickness of 0.475 in., the spacer was quickly withdrawn and the time necessary for compression to 0.100 in. was noted. Each material was run over a temperature range and the temperature at which exactly 100 sec. is required for the defined plastic deformation was reported as the "plastic temperature."

In each of the four methods described, dry specimens were tested, all machine parts coming in contact with the plastics were well cleaned between runs, and all variables except temperature were set constant. This means that in each case the temperatures at which the plastics had reached the same consistency or flowability were determined. Since different plastic types have different temperature coefficients of flowability, the relative flowability as here determined will not necessarily hold when the constants are changed. Results of the tests are given in Table I.

TABLE I. FLOW MEASUREMENTS ON VARIOUS PLASTICS
All results are from one machine, except where indicated

Type and Designation	Rossi-Peakes Flow Tester—Flow Temp., deg. Cent.	Mooney Shearing Disk Plastometer—Relative Plasticity, deg. Cent.	Modified Dillon Extrusion Plastometer—Extrusion Temp., deg. Cent.	Modified Williams Parallel Plate Plastometer—Plastic Temp., deg. Cent.
		Acrylate		
1	169.6*a*	182.0	...	...
2	156.1*a*	169.0	...	...
3	153.9*a*	173.0	...	...
4	146.4*a*	160.5	...	...
		Polystyrene		
5	135.9*a*	129.5	172.0	177.0
6	125.1*a*	121.5	154.3	145.6
7	112.5*a*	112.5	146.6	142.7
		Vinyl Co-polymer		
8	128.1*b*	141.0	158.7	170.0
9	120.4*b*	130.0	145.6	162.5
10	119.2*b*	124.0	141.4	149.5
11	118.5*b*	122.0	135.5	157.3
12	107.5*b*	111.5	129.8	134.9
13	104.0*b*	112.0	128.4	133.3
14	99.6*b*	106.0	122.4	144.7
		Cellulose Ether		
15	138.4*b*	136.1	157.2	...
16	131.3*b*	123.9	156.7	...
17	128.2*b*	122.2	159.3	...
		Cellulose Acetate		
18	151.7	155.0	178.3	...
19	150.8*c*	150.6	179.4	153.5
20	148.3*c*	149.0	174.0	165.7
21	140.8*c*	141.1	166.7	144.6
22	140.5*c*	143.3	166.9	150.5
23	138.9	141.5	166.8	148.7
24	136.7*c*	141.7	164.9	141.8
25	134.8*c*	139.4	161.3	148.7
26	131.3*c*	132.2	159.4	144.8
27	126.7	129.0	...	160.1
28	124.6	127.0	162.8	153.8
29	123.9	126.0	155.8	171.0

a Average of results from two machines.
b Average of results from three machines.
c Average of results from four machines.

In Fig. 1 the flow temperature as determined with the Rossi-Peakes flow tester is plotted against the relative plasticity as determined with the Mooney shearing disk plastometer. The curves for each plastic type, represented by the broken lines, as well as the average curve, represented by the solid line, have been drawn as straight lines having slopes of unity. Therefore, in the equation for a straight line:

[6] Ira Williams, "The Plasticity of Rubber and Its Measurements," *Industrial and Engineering Chemistry*, Vol. 16, No. 4, p. 362 (1924).

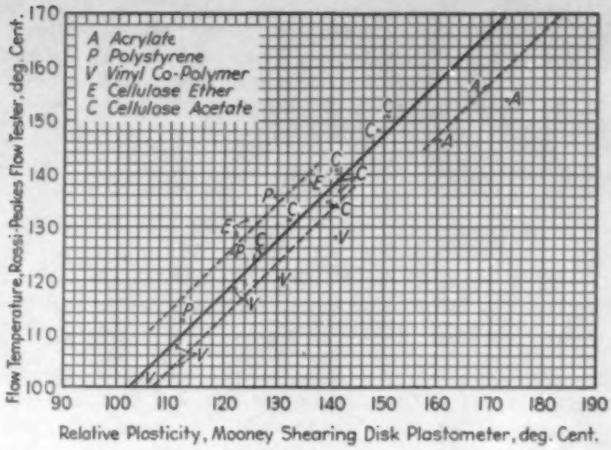

A Acrylate
P Polystyrene
V Vinyl Co-Polymer
E Cellulose Ether
C Cellulose Acetate
Flow Temperature, Rossi-Peakes Flow Tester, deg. Cent.
Relative Plasticity, Mooney Shearing Disk Plastometer, deg. Cent.

Fig. 1.

$$Y = mx + b$$

where Y = the flow temperature in degrees Centigrade,
x = the relative plasticity in degrees Centigrade,
m = 1, and
b = −3 deg. C. (average).

This may be expressed as:

Flow temperature = relative plasticity − 3 deg. C. This conversion ratio is accurate to approximately ±10 deg. C. When more accurate conversions are wanted a specific ratio must be set up for each plastic type. The *b* values suggested are:

Type of Plastic	*b* Value
Cellulose acetate	− 3 deg. C.
Cellulose ether	+ 4 deg. C.
Polystyrene	+ 4 deg. C.
Vinyl co-polymer	− 7 deg. C.
Acrylate	−13 deg. C.

The amount of data present here is not sufficient to establish definitely the conversion ratios, but by testing a sufficient range of materials of any given plastic type, accurate ratios can be established. It is possible that when more information is available, the curves for widely different plastic types might be found to differ somewhat from those given in slope or even in shape.

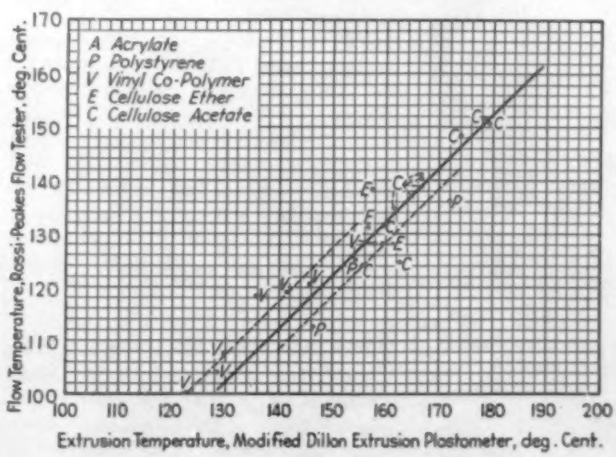

A Acrylate
P Polystyrene
V Vinyl Co-Polymer
E Cellulose Ether
C Cellulose Acetate
Flow Temperature, Rossi-Peakes Flow Tester, deg. Cent.
Extrusion Temperature, Modified Dillon Extrusion Plastometer, deg. Cent.

Fig. 2.

In Fig. 2 the flow temperature as determined with the Rossi-Peakes flow tester is plotted against the extrusion temperature as determined with the modified Dillon extrusion plastometer. Here, as in the previous case, the curves for each plastic type as well as the average curve have been drawn as straight lines having slopes of unity. The average conversion ratio is the same except for the *b* value and may be expressed as:

Flow temperature = extrusion temperature − 28 deg. C. which is accurate to approximately ±5 deg. C.

When more accurate conversions are wanted a specific ratio must be set up for each plastic type. The *b* values suggested are:

Type of Plastic	*b* Value
Cellulose acetate	−28 deg. C.
Cellulose ether	−28 deg. C.
Polystyrene	−32 deg. C.
Vinyl co-polymer	−23 deg. C.

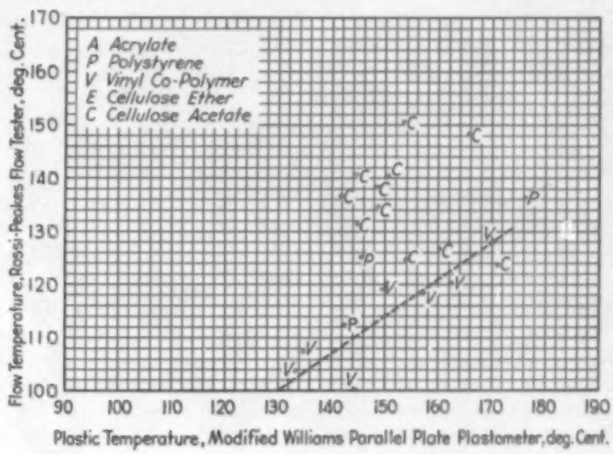

A Acrylate
P Polystyrene
V Vinyl Co-Polymer
E Cellulose Ether
C Cellulose Acetate
Flow Temperature, Rossi-Peakes Flow Tester, deg. Cent.
Plastic Temperature, Modified Williams Parallel Plate Plastometer, deg. Cent.

Fig. 3.

As in the previous case accurate conversion factors can be established by testing a sufficient range of materials of any given plastic type. Also, it is possible that when more information is available, the curves for widely different plastic types might be found to differ somewhat from those given in slope or even in shape.

In Fig. 3 the flow temperature as determined with the Rossi-Peakes flow tester is plotted against the plastic temperature as determined with the modified Williams parallel plate plastometer. The points are too widely scattered to suggest an average curve. However, there seems to be some order to the vinyl co-polymer and polystyrene materials. It is quite possible that conversion ratios can be established for similar groups of materials; that is, groups in which the difference in composition is not in the basic materials but in their ratio.

Conclusions

It is possible to correlate accurately the flow temperature as determined by the Rossi-Peakes flow tester with the relative plasticity as determined by the Mooney shearing disk plastometer and with the extrusion temperature as deter- (*Please turn to page 84*)

Plastics Digest

This digest includes each month the more important articles (wherever published) which are of interest to those who make plastics materials or use them. Requests for copies of the magazines mentioned should be directed to the individual publishers whose addresses will be mailed upon receipt of a self-addressed stamped envelope

General

IF WAR COMES. Modern Packaging *14*, 31–7, 96–115 (Oct. 1940). This is a survey of how the packaging industry may be affected by wartime economic changes and what can be done to prepare for such contingencies. Part 1 discusses "War Packaging in Great Britain," where paper control and aluminum restriction are of prime importance; Part 2 considers "Packaging under the Axis," where the greatest emphasis has been upon metal container substitutes; Part 3 relates to "The Domestic Situation," particularly the outlook for tin, paper, rubber, glass, cork, aluminum, and plastics. The position of plastics in the packaging field in England, Germany, and the United States is covered in these reviews. Of special interest is the section dealing with the development of plastic collapsible tubes in Germany.

PLASTICS IN 1940. Fortune *22*, 88–96+ (Oct. 1940). A non-technical discussion of plastics and their applications and of the present trends with respect to the corporate structure of the industry.

PLASTIC MATERIALS. L. Frossard. Plastics *4*, 208–9 (Sept.); 229–32 (Oct. 1940). Historical and chemical survey of plastics.

MODERN AIRCRAFT MATERIALS AND THEIR TESTING. K. R. Jackman. SAE Journal *47*, 461–73, 496 (Nov. 1940). A review of the new materials which recently have found favor in the production of aircraft, including the plastic-plywood type, and new fabrication uses of standard materials.

Materials and Manufacture

FROM LAB TO INDUSTRY. Business Week *1940*, 57–9 (Sept. 14). American Cyanamid Co. is about to begin full-scale production of two important raw materials for chemical synthetics. These are acrylonitrile, which is combined with butadiene in the manufacture of a buna-type synthetic rubber, and melamine which is reacted with formaldehyde to produce a synthetic resin useful in protective coatings and molding and laminating compounds.

Applications

BEARINGS FOR STEERING JOINTS. Plastics *4*, 221 (Oct. 1940). A shock-resistant grade of phenolic-molding compound is used in England to mold bearings for automobile steering joints. A small amount of colloidal graphite in the molding compound eliminates the need of lubrication. The steel surfaces of the bearing are chromium-plated to prevent rusting and consequent "filing" of the plastic. The bearing must have a load of about 100 lb. per sq. in. or more to run satisfactorily. Phenolic plastic is also used to mold the plungers which press against the brake shoes in an English hydraulic brake system.

CLOTHING FOR PROTECTION AGAINST OCCUPATIONAL SKIN IRRITANTS. L. Schwartz, L. H. Warren, and F. H. Goldman. Public Health Reports *55*, 1158–63 (June 28, 1940). Resin films and fabrics coated with them were tested for permeability to carbon tetrachloride, ethylene dichloride, ligroin, mineral oil, vegetable oil, ethyl alcohol, 20% hydrochloric acid, and 40% potassium hydroxide. Of the materials tested, Pliofilm, Vinylite, and Koroseal were found most resistant to these reagents. The fabrics laminated or impregnated with the resins were more permeable than the resinous films. Cellophane and oiled cloth were unsuitable for protection against these chemicals. Suggested designs for fashioning protective clothing from plasticized resinous films are outlined.

NEW TYPE OF TRAFFIC MARKER. Roads and Streets *83*, 89 (Sept. 1940). "Armor-Flex," a 1/8 in. thick plastic applied with a special bituminous cement to any type of pavement surface, is still giving good service after 8 years. The markers are available in white, yellow, red, and black.

SUPERPRESSED PLYWOOD. Mech. Eng. *62*, 748–51 (Oct. 1940). Comments on a paper previously abstracted in Modern Plastics, May 1940, page 58.

ETHYLCELLULOSE RIGID CONTAINER SHEETING. S. L. Bass and F. C. Dulmage, Jr. Modern Packaging *14*, 88, 102 (Sept. 1940). Flexibility, toughness, dimensional stability, printability, and ease of fabrication characterize this new addition to the transparent sheeting family.

Coatings

PAINTS TO REFLECT ULTRAVIOLET LIGHT. D. F. Wilcock and W. Soller. Ind. and Eng. Chem. *32*, 1446–51 (Nov. 1940). The absorption of ultraviolet light by various oils, resins, cellulose derivatives, plasticizers, and pigments was determined. Paints with maximum ultraviolet reflectance were formulated with ethylcellulose, vinyl copolymer, and isobutyl methacrylate resin. These paints are proposed for interior use in rooms in which ultraviolet lamps are used for therapeutic purposes.

PROTECTION OF AIRCRAFT PLYWOOD. R. B. Anderson. Aero Digest *37*, 137–8 (Oct. 1940). Tests on coatings over plywood included moisture resistance, adhesion, flexibility, and outdoor durability. A coating for a plywood fuel tank, which in a gasoline immersion test limits the increase in weight of the plywood after 49 days to 2 percent, is mentioned. Putties for sealing nail holes and joints in plywood were investigated.

BRITTLE COATINGS AS AN AID TO STRESS ANALYSIS. A. V. de Forest and G. Ellis. J. Aero. Sciences *7*, 205–8 (Mar. 1940). The fracture of brittle coatings has long been recognized as a method of studying strain distribution. This paper describes an improved brittle coating in the form of a sprayable lacquer which air-dries overnight to form a coating of uniform brittleness within the limits of .003 to .008 in. thickness. A calibration method makes possible quantitative estimation of strain to within an error of 15 percent.

SPIRIT VARNISHES. R. C. Ernst, J. B. Tepe, and I. W. Hutchison, Jr. Ind. and Eng. Chem. *32*, 1539–40 (Nov. 1940). Spirit varnishes in which ethylcellulose was substituted for from 5 to 25 percent of the resin content were tested to determine the effect on hardness, resistance to moisture, cold-checking, and resistance to abrasion. In all of these properties, the spirit varnishes were materially improved by the addition of ethylcellulose. These inexpensive, quick-drying protective coatings are used as label and carton finishes and as traffic paints for marking highways.

PUTTING THE HEAT ON WHITE ENAMELS. J. M. Sanderson. Metal Finishing *38*, 565–8 (Oct. 1940). The relative merits of the urea-formaldehyde, alkyd, and new melamine resins are reviewed.

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U. S. Plastics Patents

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STENCIL. B. F. Walker (to Metaplast Corp.). U. S. 2,200,314, May 14. A stencil for applying a design to a surface has a base with disconnected openings forming the design and in partial register with openings in a stencil cover through which liquid is supplied.

PLASTICIZER. W. D. R. Straughn (to E. I. du Pont de Nemours and Co.). U. S. 2,207,702, July 16. Plasticizing cellulose acetate films with 10 to 40 percent of glycol diglycolate.

METALLIZING PLASTICS. B. F. Walker (to Metaplast Corp.). U. S. 2,214,646, Sept. 10. Decorative metallizing of molded articles by treatment first with stannous chloride and then with silver nitrate.

NONCHALKING LACQUER. G. R. Ensminger (to E. I. du Pont de Nemours and Co.). U. S. 2,214,667, Sept. 10. A nitrocellulose lacquer with high resistance to chalking and bronzing is plasticized and compounded with an alkyd resin modified with 35 to 60 percent of a nondrying oil.

PHOSPHONITRILE RESIN. D. Lipkin (to Atlantic Refining Co.). U. S. 2,214,769, Sept. 17. Condensing phosphonitrilic chloride with butylamine to form a light-colored resin, insoluble in organic solvents.

AMINOPLAST. G. F. D'Alelio (to General Electric Co.). U. S. 2,214,851, Sept. 17. Adding an aminoester to a solid fusible aminoplast as an accelerator of curing.

ELECTROLYTIC CAPACITOR. F. M. Clark (to General Electric Co.). U. S. 2,214,876–7–8, Sept. 17. Using an alkali-soluble resin in aqueous emulsion, or chlorinated paraffin, or an electrolyte-permeable resin as a coating on the metal films in electrolytic capacitors.

MORTAR-BOUND GLASS. R. R. MacGregor and E. L. Warrick (to Corning Glass Works). U. S. 2,215,048, Sept. 17. Glass bricks are bonded with mortar coated with ethyl silicate and polyvinyl acetate.

CASEIN PLASTICS. C. Schwartz (to Hall Laboratories, Inc.). U. S. 2,215,137, Sept. 17. Extruding alkaline casein solution into an aqueous metaphosphoric acid coagulating bath.

LACQUERED CANS. Wm. Clayton; Wm. Clayton, R. I. Johnson and C. G. Sumner; Wm. Clayton and H. K. Dean (all to Crosse and Blackwell, Ltd.). U. S. 2,215,143–4–5, Sept. 17. Lacquering the inside of food tins by electrophoretic deposition of a transparent lacquer; or by similar deposition of a wax in presence of a food-permissible alkaline salt; or by deposition of a drying oil and a resin from an aqueous dispersion with the can as anode.

GLYCOL ACRYLATE. E. H. Haux (to Pittsburgh Plate Glass Co.). U. S. 2,215,219, Sept. 17. Making a resinous polymer of glycol acrylate from ethylene chlorohydrin and sodium cyanide.

THERMOPLASTIC. W. W. Pedersen (to Dow Chemical Co.). U. S. 2,215,249–50, Sept. 17. Molding thermoplastic ethylcellulose compositions with the aid of esparto grass wax or a neutral refined mineral oil as mold lubricant.

SHOE COVERING. Kurt Vasen. U. S. 2,215,340, Sept. 17. Coating footwear with a thin, tough film of vinyl resin as a temporary protecting covering while on display.

BUTADIENE INTERPOLYMERS. L. B. Sebrell (to Wingfoot Corp.). U. S. 2,215,379, Sept. 17. Interpolymerizing butadiene with vinylidene chloride.

BONDED ABRASIVE. R. C. Swain and D. W. Light (to American Cyanamid Co.). U. S. 2,215,380, Sept. 17. An aminotriazine-aldehyde resin as binder for abrasive grains.

VINYLCARBAZOLE PRODUCTS. H. Beck and E. Dorrer (to General Aniline and Film Corp.). U. S. 2,215,573, Sept. 24. Molding packed fibers of polyvinylcarbazole by partial fusion.

DECORATIVE PANELS. A. B. Saunders (to Johns-Manville Corp.). U. S. 2,215,595, Sept. 24. Baking a pigmented vinyl resin undercoater on a smooth board base, forming a vinyl resin film in a design on a vinyl resin backing and applying it to the undercoater, fusing the coats together under pressure and finally applying a baked vinyl resin finish.

MOLDING COMPOSITION. F. Seebach (to Union Carbide and Carbon Corp.). U. S. 2,215,596, Sept. 24. Condensing a phenol with an aldehyde in aqueous solution, cooling to form a solid resin with water dispersed therein, and allowing the water to act as plasticizer.

PLASTICIZER. P. J. Gaylor and W. J. Sparks (to Standard Oil Development Co.). U. S. 2,215,601, Sept. 24. Plasticizing cellulose esters with allyl chloride polysulphone.

VINYL RESINS. D. L. Gibb and R. D. Freeman (to Dow Chemical Co.). U. S. 2,215,733, Sept. 24. Forming bubble-free polyvinyl resin molded shapes in elongated molds by progressively cooling a melt from end to end of the mold.

FISHING LINE. Robert Ledrich. U. S. 2,215,760, Sept. 24. Floatable fishing line impregnated with polyvinyl chloride.

NAIL POLISH. R. J. Anderson (to Vorac Co.). U. S. 2,215,898, Sept. 24. A nitrocellulose lacquer containing not over 5 percent of a neutral water-soluble organic solid.

EXTRUSION MIX. B. W. Nordlander and R. E. Burnett (to General Electric Co.). U. S. 2,216,020, Sept. 24. Adding an amine to a vinyl resin to inhibit setting of the resin to an infusible insoluble state during extrusion.

SULPHURIZED PLASTIC. J. C. Patrick (to Thiokol Corp.). U. S. 2,216,044, Sept. 24. A heat-curing plastic made by polymerizing an olefin:polysulphide product.

POLYSTYRENES. E. C. Britton, H. B. Marshall and W. J. LeFevre (to Dow Chemical Co.). U. S. 2,216,094, Sept. 24. Comminuting a styrene interpolymer gel by swelling in a solvent, comminuting the gel and precipitating the gel as a fine powder.

GRINDING WHEEL. E. T. Rainier (to U. S. Rubber Co.). U. S. 2,216,135, Oct. 1. Incorporating an alkali metal or alkaline earth salt, melting between 700 and 1200 deg. C., in a phenol-aldehyde resin binder for abrasive grains.

(Please turn to next page)

GENERAL SUBJECTS

Historical Background of the Plastics Industry
Polymerization Phenomena and the Formation of Plastics
Introduction to Organic Chemistry
Formation of Phenolic Plastics
Urea Resins and Their Characteristics
Polyvinyl Resins and Their Characteristics
Acrylic and Polystyrene Resins
Cellulose Plastics — Origin and Chemistry
Introduction to Cellulose Chemistry
Utilization of Farm Products and Waste Materials in Plastics
Miscellaneous Resins (Including Natural Resins, Rubber Derivatives, Alkyds and the Polyamides)
Synthetic Rubbers and Rubber-Like Materials
Rubber Chemistry — Introduction
Physical Properties of the Plastic Materials
Review of Strength of Materials
Electrical Properties of Plastic Materials
Chemical Properties of Plastic Materials
Optical Properties of Plastics
Design of Molded Plastic Parts
Insulating Foils, Threads, and Packaging Materials
Molding of Plastics—Materials—General
Molding of Plastics—Procedure—General
Cold Molding and Material Properties
Mold—Design—General
Laminated Plastics—General
Casting of Plastics—General
Extruding of Plastics
Fabrication of Plastics by Drawing, Forming and Cementing—General.
Testing Methods for Plastics—General
Plastics As Applied to Surface Coatings
Economics of Plastics and Their Applications—General
Styling and Art In Plastics

ELECTIVE SUBJECTS

MOLDING — Study of Molding Materials and Flow Properties.
Dependence of Properties of Materials Upon Methods of Molding.
Preparation of Materials for Molding.
Types of Compression Molding Presses (Operations and Maintenance).
Types of Injection Molding Presses (Operations and Maintenance)
Extrusion Presses and their operation.
Review of Mold Types
Fully Automatic and Semi-Automatic Molding.
Heat and Pressure Developing Means.
Accessories For Molding and Their Design.
Molding Plant Layout.
Finishing Operations and Inspection.

MOLD DESIGN AND CONSTRUCTION—
Fundamental Requirements of Thermosetting and Thermoplastic Composition in Molding.
Types of Molds (Flash and Positive).
Injection and Transfer Mold Design .
Materials Employed in Mold Construction.
Machining and Hobbing Molds (Theory)
Special Methods for Making Molds.
Design of Shrink Fixtures, and Tools For Finishing Plastic Materials.
Gauges For Checking Mold Construction.
Design of Extrusion Dies, Preforming Molds, etc.

CASTING — Materials Suited for Casting Purpose.
Production Techniques Developed For Casting Phenolic Resins and Acrylic Resins.
Molds For Cast Phenolics-Steel Mandrels and Rubber Molds.
Preparing Composite Castings of Two or More Materials.
Properties of Cast Plastic Materials as Compared With Other Grades.
Casting of Thin Films.

LAMINATING — Procedure of Impregnating Fabrics, Paper, Asbestos and Wood.
Presses and Equipment Required for Laminating Plastic Materials.
Classifications of Phenolics According to the N.E.M.A.
Lamination of Rods, Tubes, and Bearings.
Physical, Electrical, and Chemical Properties of Laminated Plastic Materials.
Special Machining and Finishing Requirements for Plastic Materials.
Use of Uncured Scrap From Laminated Plastics in the Manufacture of Special Gears and Pulleys.
Laminating of Wood Veneers and Papers Through the Use of Thermoplastic Sheets and Resin Films.
Design of Molds for Laminating.
Methods of Applying Laminated Plastics.

FABRICATING —Thermoplastics Qualities of Plastic Materials.
Selection of Materials and the Colors Available.
Molds and Forms Useful For The Forming and Drawing of Plastic Materials.
Preparation of Various Cements and Solvents.
Methods of Assembling Plastic Materials.
Special Techniques For the Fabrication and Forming of Laminated Phenolics and Laminated Urea Plastics.
Applications and Uses of the Various Extruded Plastics.
Manufacture of Various Articles from Plastic Sheets and Rods.
Treatment of Cloth To Render It Waterproof.
Finishing Treatments For Thermoplastics.
Comparative Machining Characteristics of Plastic Materials With Emphasis on Cast Phenolics.
Packaging Materials.

TESTING — Why Plastics Differ From Other Materials of Construction and Wherein Test Methods Will Differ.
A.S.T.M. Procedures and Dependence Upon Humidity and Temperature.
Procedure For Creep and Cold Flow Measurements: Special Optical Tests, etc.
Special Tests by Materials Manufacturers.

DESIGNING AND STYLING WITH PLASTICS—
Relationship of Art to Civilization
Industrial Art and Design.
Plastics in Modern Design and Merchandising.
Plastics in Decoration.
Plastics in Architecture.
Plastics in Business.

MERCHANDISING OF PLASTICS — Marketing of Plastics.
Marketing Finished Plastics Products.
Knowing your Product.
Wholesale and Retail Selling.
Sales Technique.
Review and Survey of Plastics Market.

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ILLUSTRATED LITERATURE MAILED UPON REQUEST

EMULSION COATING. F. M. Beegle and H. L. Andrews, Jr. (to Congoleum-Nairn, Inc.). U. S. 2,216,180, Oct. 1. The organic vehicle in an emulsion paint comprises 50–95% drying oil and 5–50% of an oil-soluble phenol-aldehyde resin.

CELLULOSIC EMULSION. A. Dreyling and W. W. Lewen (to E. I. du Pont de Nemours and Co.). U. S. 2,216,233, Oct. 1. Making a pasty emulsion of a cellulose derivative with the aid of gum ghatti and another emulsifying agent.

INSULATING ENAMEL. F. J. Emig (to E. I. du Pont de Nemours and Co.). U. S. 2,216,234, Oct. 1. An alkyd resin insulating enamel contains perilla, tung and fish oils, rosin and a mixture of driers.

CABLE INSULATION. J. F. Eckel (to Western Electric Co.). U. S. 2,216,435, Oct. 1. Covering cables with a layer of rosin, rosin oil and polyisobutylene, then with a metal sheath.

ACETAL RESIN FOIL. H. B. Smith and D. R. Swan (to Eastman Kodak Co.). U. S. 2,216,461, Oct. 1. Rubbery foils of polyvinyl acetal resin plasticized with the ethyl ether of diethyleneglycol succinate.

DOORKNOB. M. Falk (to Independent Lock Co.). U. S. 2,216,467, Oct. 1. Improved interlocking attachment device for a molded doorknob.

CORROSION-RESISTING PAINT. D. Isenberg (to Surface-Proofing Products, Inc.). U. S. 2,216,514, Oct. 1. A pigmented alkyd resin finish for protecting metal surfaces.

SHOE STIFFENER. R. Almy (to Armstrong Cork Co.). U. S. 2,216,580–1, Oct. 1. Thermoplastic shoe stiffeners containing rubber finely dispersed in the thermoplastic to improve springiness and flexibility.

PHOTOGRAPHIC FILM. W. H. Carothers (to E. I. du Pont de Nemours and Co.). U. S. 2,216,735–6, Oct. 8. Making a waterproof flame-resisting transparent film base from a synthetic linear polyamide, which gives longer wear in projectors than does acetate film.

MOISTUREPROOF FOIL. R. B. Flint (to E. I. du Pont de Nemours and Co.). U. S. 2,216,812, Oct. 8. Moistureproofing transparent foils with a cellulose ester, ether or ether-ester plasticized with a polyarylamide of a long chain fatty acid.

MOISTUREPROOF FOIL. J. A. Mitchell (to E. I. du Pont de Nemours and Co.). U. S. 2,216,826–7, Oct. 8. Plasticizing moistureproofing coatings with an N-monoarylamide or an N-substituted amide of a long chain fatty acid.

POLYMERS. W. H. Carothers (to E. I. du Pont de Nemours and Co.). U. S. 2,216,835, Oct. 8. Plasticizing synthetic linear polyamides with halogenated hydrocarbons or halogenated ethers.

PETROLEUM RESIN. A. H. Gleason (to Standard Oil Development Co.). U. S. 2,216,941, Oct. 8. Condensing an aromatic olefin-free petroleum distillate with formaldehyde and a fatty acid in presence of zinc chloride to form a resin.

PHONOGRAPH RECORD. J. H. Hunter (to Radio Corp. of America). U. S. 2,216,946, Oct. 8. Using powdered marble as filler in resin plastic phonograph record compositions.

MOLDING COMPOSITION. D. E. Cordier (to Plaskon Co., Inc.). U. S. 2,217,006, Oct. 8. Thermosetting molding compositions comprising a urea-formaldehyde resin plasticized with alkyl-, dialkyl-, hydroxyalkyl- or bis(hydroxyalkyl)ureas.

RUBBERY POLYMER. Herman B. Kipper. U. S. 2,217,057, Oct. 8. Interpolymerizing mixed butylenes with acetylene at about −80 °C. in presence of boron trifluoride and copper chloride to form a rubber substitute.

SYNTHETIC WOOL. V. R. Hardy (to E. I. du Pont de Nemours and Co.). U. S. 2,217,113, Oct. 8. Imparting wool-like character to synthetic linear polyamide filaments by compressing a mass of the filaments and treating with a mild swelling agent.

PLASTIC. D. A. Fletcher (to E. I. du Pont de Nemours and Co.). U. S. 2,217,163, Oct. 8. Plasticizing a vinyl formal resin with a dialkyl (dihexyl to dioctyl) phthalate.

PHONOGRAPH RECORD. J. H. Hunter (to Radio Corp. of America). U. S. 2,217,170, Oct. 8. Use of lead titanate as filler in vinyl resin phonograph record compositions.

SHOE STIFFENER. M. C. Kumnick and Q. L. Quinlivan (to Celastic Corp.). U. S. 2,217,171, Oct. 8. Making a molded nonreinforced shoe stiffener blank of plasticized ethylcellulose.

PROTECTING WOOD. F. E. Cislak (to Peter C. Reilly). U. S. 2,217,265, Oct. 8. Creosoted wood is given additional protection by coating it with a solution of a thermosetting phenol-formaldehyde resin and a catalyst to accelerate setting.

UREA RESIN. O. R. Ludwig (to Resinous Products and Chemical Co.). U. S. 2,217,372, Oct. 8. Condensing urea with formaldehyde first in butanol solution, then in butanol faintly acidified with formic acid.

INSULATED WIRE. W. I. Patnode (to General Electric Co.). U. S. 2,217,451, Oct. 8. Extruding plasticized polyvinyl chloride on preheated wire, flash heating and flash cooling to melt the coating and set it quickly.

AUXILIARY LENS. F. E. Goehring, Sr. U. S. 2,217,475, Oct. 8. An auxiliary lens for spectacles has a clip attachment and is molded from a transparent plastic.

CIGARET. Leo Roon (to Roxalin Flexible Lacquer Co., Inc.). U. S. 2,217,527, Oct. 8. Coating cigaret tips externally with waterproof ethylcellulose, and bonding the tobacco together and to the paper at the tip with ethylcellulose.

RUBBERY PLASTIC. Wm. D. Wolfe (to Wingfoot Corp.). U. S. 2,217,631, Oct. 8. Interpolymerizing butadiene with acrylonitrile or with styrene in presence of a nitrosoaniline derivative.

MOLDING THREADED ARTICLES. D. M. Anderson (to Standard Products Co.). U. S. 2,217,661, Oct. 15. A mold having separable mold members forming circular cavities radially interconnected through gate recesses, for molding threaded articles.

ETHER RESIN. H. A. Bruson and J. L. Rainey (to Resinous Products and Chemical Co.). U. S. 2,217,667, Oct. 15. Condensing a thioammeline diethyl ether with excess formaldehyde and completing the condensation with urea.

PLASTICIZERS. M. J. Reid (to Eastman Kodak Co.). U. S. 2,217,706, Oct. 15. In recovering plasticizers from cellulose acetate the crude plasticizer, after removing the extraction solvent, is dissolved in a hydrocarbon solvent and precipitated with water.

HOLLOW ARTICLES. Camille Dreyfus. U. S. 2,217,734, Oct. 15. Molding doll heads and other hollow shapes from cellulose derivatives around a fragile glass core, and removing the core by shattering it.

CHITIN PRODUCTS. C. J. B. Thor (to Visking Corp.). U. S. 2,217,823, Oct. 15. Drinking straws, tubing, films and filaments are formed from mixed chitin xanthate and cellulose xanthate, instead of straight viscose, by regenerating the chitin and cellulose after extrusion.

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● THE NATIONAL METAL TRADES ASSN., 122 S. MICHIgan Ave., Chicago, Ill., has issued a Machine Shop Instructor's Manual which contains instruction outlines designed to help train inexperienced men to become capable machine operators or specialists in the shortest possible time. Training of industrial workers is just as important as training of soldiers and sailors under our National Defense Program, the association believes.

There are two basic questions back of any training program: (1) What does the learner need to know? (2) What is the best way to tell or show the learner what he needs to know at a time when he should know it? To assist everyone in the shop, who has anything to do with training, to recall exactly what the learner needs to know, this series of instruction outlines has been prepared for the following occupations: assembly, drill press—upright, drill press—radial, engine lathe, turret lathe, hand milling machine, milling machine, cylindrical grinding, surface grinding, shaper, planer, vertical boring mill, horizontal boring machine, vertical turret lathe.

These outlines purposely deal neither with the detailed information or facts to convey to the learner, nor how and when to present them. They do, however, serve as a check list of instruction points which must be covered if the new employe is to learn to do his job well. For example, the instruction points indicated in the training outline for the Engine Lathe are: machine description, nature of operations, care of machine, coolant—how, when, and why used, safety, tools, machine controls, loading work, operation details, gaging, removing work, tool grinding. In addition to pointing out the elements of instruction to be covered, the manual indicates certain reference material for home study which may prove of considerable assistance, if used, by giving the learner information necessary to fully understand his job. The references in Machine Shop Technology, the National Metal Trades Association Textbook for Apprentices, furnish general information on the uses of the machine tool and methods of operation; those in the Manufacturers' Books give specific information regarding the machine in question; and the Plant Safety Rules, to which reference is also made, outlining the policy of each company with regard to safe practice.

With many companies unable to establish special training departments or to employ a special instructor, the training responsibilities fall upon foremen who, in turn, may delegate this duty to one of the experienced operators in his department. Any person, it is stated, who has become proficient over a period of time, is apt to either overlook some of the essential details of his job when he is explaining them or to assume that the learner already knows them because the details seem so obvious. Whenever, therefore, the person who is responsible for training takes the time to analyze the job in terms of what the learner needs to know and sets those things down to make sure the instructor does not overlook them, a better job will be done.

In addition to these outlines, there has also been prepared: (1) Suggestions to Management in applying this program; (2) Suggestions to the Instructor; (3) A Proposed Letter to Learners, to be released over the signature of a responsible executive of the company.

● METALLIC SOAP DIVISION OF WARWICK CHEMIcal Co., West Warwick, R. I., has issued a new technical bulletin on metallic soaps and their uses. This comprehensive booklet is free for the asking.

● A 42-PAGE, PLASTIC BOUND BOOK ON BEETLE molding materials has been issued by the Beetle Products Div., American Cyanamid Co., 30 Rockefeller Plaza, New York. Well organized and presented, the book discusses pertinent information regarding the urea-formaldehyde compounds sold under this trade name. Subjects treated include: processing or molding, preforming, prewarming, flow, molds; molding, temperature, molding pressures, cure and finishing operations; the correction of molding defects, storage of finished parts, shrinkage; properties of molding materials and finished parts; applications; design; tapping and drilling; miscellaneous tables and charts. Color plates, graphs and diagrammatic drawings help to make the book complete and valuable.

● DOALL SAWS, INC., 1201–1225 THACKER STREET, Des Plaines, Ill., has issued a handbook on its saws. The first half of the book explains the variables that are found in several types of narrow saws, shows how they are used and cutting speeds that should be employed on various materials. The center spread of the booklet shows the plant layout in which the saws are made. The last half of the book is devoted to actual case histories of testing jobs and are submitted by customers.

● A LEAFLET GIVING DIRECTIONS FOR HANDLING, cleaning and polishing Plexiglas has been issued by Röhm and Haas Co., Inc., 222 W. Washington Sq., Philadelphia, Pa. The pamphlet may be secured from the firm upon request.

● A PAMPHLET ENTITLED *SELECTING THE RIGHT Steel for Plasting Molding* has been issued by the Crucible Steel Co. of America, 405 Lexington Ave., New York City. Qualifications and recommendations with reference to specific applications are discussed. The 8-page booklet is illustrated.

● A 4-PAGE BULLETIN RELEASED BY THE H AND H Research Co., 12540—12th St., Detroit, Mich., describes their 2 Junior models and 4 Senior models of reciprocating multipurpose tools. It fully describes the many operations that have been found for the use of this tool, which range from highly special applications to the use of tools equipped with files, which may be used to burr heavy steel forgings on production jobs.

● A CATALOG ILLUSTRATING AND DESCRIBING THE new 16″ Series "S" precision lathe, has just been published by South Bend Lathe Works, South Bend, Inc. The catalog features the new lathe, which is made in three types: toolroom, quick change gear, and standard change gear. Attachments for toolroom production and maintenance work are described, and features of construction are outlined in detail.

● H. K. PORTER CO., INC., 4956 HARRISON ST., PITTSburgh, Pa., has issued a 4-page bulletin describing its new double cone blender. Designed to eliminate waste of time and materials in the blending of chemicals, plastics, pharmaceuticals and similar products, the machine is described in complete detail in the new circular. A chart listing sizes, horsepower required, weight and other pertinent data, is included.

● BELL AIRCRAFT CORP., BUFFALO, N. Y., HAS ISsued an interesting booklet describing the services of their commercial testing laboratories division. The laboratory houses complete apparatus for the three divisions of X-ray, physical and chemical testing, as well as heat treating and salt spray equipment, Rockwell hardness testing machines, impact testers, densitometers, tensile testing machines, fatigue testers and many other machines. The booklet states that the laboratory, its facilities and personnel are available to manufacturers and others requiring this type of work.

THE *Precision* REQUIRED FOR MODERN INDUSTRY

South Bend Lathes are designed and built to provide the extreme precision required in modern industry. They are giving tool room accuracy on close-tolerance production work in hundreds of manufacturing plants throughout the United States. The smooth, vibration-free belt drive to the spindle permits finish turning or boring with such precision that subsequent grinding, honing or lapping operations can often be eliminated.

South Bend Lathes are made in 9″, 10″, 13″, 14½″ and 16″ swing, in 3′ to 12′ bed lengths, in Motor Drive and Countershaft Drive.

SOUTH BEND LATHES

SOUTH BEND LATHE WORKS

LATHE BUILDERS SINCE 1906

188 E. Madison St., South Bend, Ind., U.S.A.

Machinery and Equipment

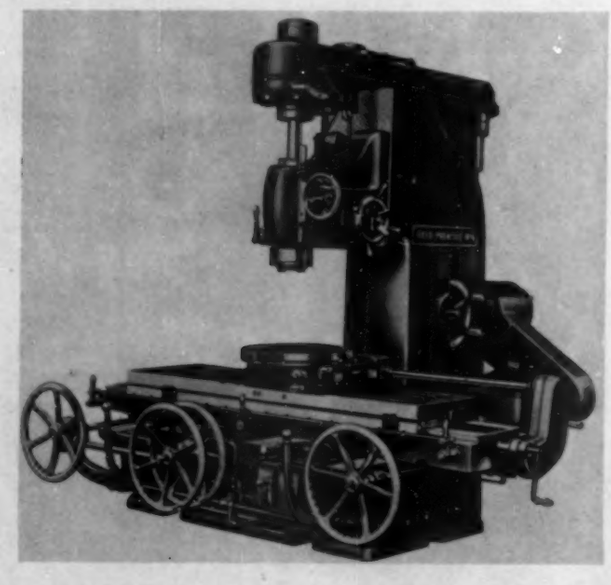
● WITH HASTE AND MORE HASTE THE ESSENCE OF the National Defense Program, a recent announcement by the Independent Pneumatic Tool Co., of a new method of handling screws on assembly operations is of particular interest. This new method will, it is claimed, increase by 3 to 9 times in many instances the already established efficiency of power driving of screws. A device, known as the Thor "Pix-Up" Finder and Adjusto-Tray, shown above, sorts, picks up and holds screws for driving. It eliminates the time-wasting hand operations of picking up screws by the fingers and starting or holding the screw in tapped or drilled hole. Not magnetic, but entirely mechanical, the unit is extremely simple in design and operation.

The unit consists of a novel arrangement of a screw-holding tray, which is spring mounted on a base and adjustable by clamp screws at each of four corners for the particular length of screw to be driven. The tray has a series of longitudinal slots. Into this tray a quantity of screws are spilled; shaking the tray a few times suspends the screws in the slots by their heads. A power screw driver equipped with the finder is then placed over a screw head, pressed and, as the tray depresses slightly, the finder grips the screw head firmly in perfect alignment, holding it ready for the driving operation. The finder itself is an extension type that is fitted to the power screw driver.

● GEORGE SCHERR CO., INC., ANNOUNCES THAT IT has just brought out its own line of machinists' tools. The line consists of machinists' combination sets with drop-forged hardened square heads, hardened center head, hardened blade and reversible protractor head; a machinists' combination set with hardened blade and center head, protractor and square head of cast iron, 4-in., 6-in. and 8-in. dividers; 4-in., 6-in. and 8-in. inside and outside spring calipers; hardened and tempered center gages; thickness gages; depth gages; surface gages; magnifiers. Nook, sliding caliper, flexible and narrow tempered rules are also included in this line.

● NEW CARBON BRUSHES CAN BE SEATED ACCURately and quickly, it is claimed, without danger to commutator surface with a new device recently announced by the Ideal Commutator Dresser Co. The old brush is used as a template to locate the arc segment on the cutting guide slot, which arc corresponds to the contour of the commutator or slip ring. After this segment is found the new brushes may be formed without further set-up, it is stated. Any electric drill or electrical shaft drive may be used to operate the cutting head. The complete unit includes aluminum guide casting, cutting file, removable angle plate with clamping device and "C" clamp. Takes practically any size brush for 4-in. to 48-in. diameter commutator.

● ATLAS MILLING MACHINE CO. HAS INTRODUCED a compact bench machine that is claimed to cut costs on all types of small milling jobs. The unit is said to handle a full range of milling work from slabbing and facing cuts to end milling, keyway cutting, finishing and layout work. The machine is designed for modern tool room and production needs. Three types of table controls are available: standard screw feed, rapid-production lever feed and the new "Change-O-Matic" for instant selection of automatic table feeds between .125 in. and 9.125 in. per minute.



● REED-PRENTICE CORP. HAS RECENTLY BROUGHT out a No. 6 vertical milling machine and die sinking machine, shown above, that has positive gear drive to spindle, top box being totally enclosed and dustproof. The unit is claimed useful for handling large dies and general milling work. The main drive pulley is provided with clutch and brake for start and stop, conveniently controlled by two levers at the front of the machine table. An entire anti-friction drive is secured from the main driving pulley to spindle with bevel gear shafts and spindle mounted on Timken taper roller bearings. The machine is designed, it is said, to secure maximum power and rigidity. The saddle extends the full length of the table, giving rigid support for heavy work. Maximum efficiency is secured through power rapid traverse to table in either direction at 95 ft. per minute.

HERE'S THE BOOK
THE PLASTICS INDUSTRY HAS BEEN WAITING FOR!

1941 MODERN PLASTICS CATALOG AND DIRECTORY

Partial Contents

PLASTIC FLOW SHEETS

SUMMARY of PLASTICS PROGRESS Statistics on Sales and Production

MATERIALS: Phenol-formaldehyde Resins: Molding Type • Phenol-furfural Resins • Phenol-formaldehyde Cast Resins • Urea-formaldehyde Resins • Cellulose Acetate • Cellulose Acetate Butyrate • Cellulose Nitrate • Ethylcellulose (and Methylcellulose) • Acrylic Resins • Alkyd Resins • Vinyl Resins (Esters) • Vinyl Acetal Resins • Styrene Resins • Paracoumaroe-indene Resins • Casein and Other Protein Plastics • Shellac • Lignin Plastic • Cold Molding Materials • Synthetic Rubbers • Synthetic Fibers • Fillers (Woodflour, Cotton Flock, Asbestos and Diatomaceous Silica, and Resin Board and Blanks) • Coloring Materials • Plastic Properties Chart.

MOLDING AND FABRICATING: Design for Plastics • Design of Molds • Metals for Molds • Construction of Molds • Preforming • Compression Molding • Injection Molding (Thermoplastics, Thermosetting Materials) • Extrusion Molding • Fabricating Phenolic Resins (Casting; Machining) • Fabricating Pyroxylin • Finishing Methods • Assembly Devices • Applied Decoration.

MACHINERY AND EQUIPMENT: Preforming Presses • Compression Presses • Man-operated: Automatic, Laboratory, Laminating • Injection Presses: Single-cylinder, Multiple-unit • Extrusion Presses • Molding Plant Equipment (except finishing equipment), (Preheating Ovens, Hydraulic Controls, Hot Water System, etc.) • Finishing Equipment.

LAMINATES: Manufacture of Laminates • Industrial Laminates, Applications • Decorative Laminates, Applications • Translucent Laminates, Applications • Resin-bonded Wood.

SYNTHETIC RESIN COATINGS: Phenolic Resin Coatings • Urea Resin Coatings • Alkyd Resin Coatings • Miscellaneous Resin Varnishes • Solvents Chart • Plasticizers Chart.

BIBLIOGRAPHY AND NOMENCLATURES.

DIRECTORY SECTION: Plastics and Raw Materials • Machinery Equipment and Supplies • Molders, Fabricators and Designers • Molders' Markings • Alphabetical list of all manufacturers and addresses.

Between the covers of this huge book is all the plastics information you'll need in the conduct of your business. There's a separate article on every plastic material, one on each method of molding and fabricating, one on every type of equipment. Complete buyers' guide to molders, fabricators, laminators, designers, etc.; to machinery, methods and equipment; to plastics and raw materials; to molders' markings—with an alphabetical listing of the names and addresses of all of these firms.

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1941 MODERN PLASTICS CATALOG AND DIRECTORY
BRESKIN PUBLISHING CORPORATION
122 East 42nd Street, New York City

In The Limelight

● THE FIRST SYMPOSIUM ON PLASTICS, SPONSORED by Lehigh University and contributed to by the Catalin Corp., Plaskon Co., MODERN PLASTICS magazine and the American Cyanamid Co., was held on October 25th at Lehigh University, Bethlehem, Pa. The meeting which took place in the Packard Auditorium of the University before the several hundred invited representatives of America's leading laminating and molding interests was opened by Dr. C. C. Williams, president of the university. Following the welcome, Dr. N. A. Neville, head of the Chemistry and Chemical Engineering Department introduced the first speaker, W. R. Thompson, technical director of the Catalin Corporation.

Mr. Thompson traced, with the aid of motion pictures taken in the laboratories and plant, the processes and improvements that have so greatly broadened the use of cast phenolic resins. He took this opportunity to announce the commercial production of cast technical resins whose suggested uses are linings for chemical tanks, non-corrosive pipe lines, production of noiseless gears, etc. He concluded his talk by bringing up to date the subject on the recently perfected laminating varnishes and adhesives for plywood and abrasive disks and wheels which, by exhaustive laboratory and field tests, have proved very satisfactory.

Movies prepared by MODERN PLASTICS magazine were then shown. This film in full color depicted typical plant operations, together with detailed views of injection and compression molding. A review of the Competition winners for 1940 demonstrated to the audience just how plastics have advanced within the last year. Dr. M. H. Bigelow, technical adviser of the Plaskon Co., closed the afternoon session with an address on the properties and uses of urea-formaldehyde resin. The scope of urea resins, Dr. Bigelow pointed out, has greatly increased in the past few years. They are not only being used to make plastic articles, but in a modified form are the basis for new adhesives and lacquers. They offer improvements in durability of finish and resistance to fading and scratching.

The evening session was opened by H. N. Haut, Chief Inspector of the Bellanca Airplane Corp., whose talk consisted of a comprehensive review of plastics in airplane construction. Mr. Haut exhibited a partially completed wing taken from the production jigs to illustrate the simplified methods of producing military planes for the U. S. Air Corps in connection with our national defense. After many years of experiment, he stated that a satisfactory resin glue had been approved by the Civil Aeronautics Authority. J. McE. Sanderson, of the Technical Service Department of the American Cyanamid and Chemical Corp., spoke on the subject of synthetic resin coatings. Recognizing the many types of plastics on the market and the urgent need for some method of classifying them so that basic definitions may be made by the technicians, Dr. R. H. Kienle, Research Director of the Calco Chemical Division of the American Cyanamid Co., made an address on the subject, "The Changing Fashions in Polymers." His material represented his thorough knowledge of the broad subject of polymers. Emphasizing the molecular structure of various types of plastics and demonstrating their groupings with models, he made an important contribution to a practical method of appreciating the chemical reactions involved in the production of most plastics.

● ELMER E. MILLS CORP., CHICAGO, ILL., HELD open house at their offices and plant on November 8th. There were over 400 guests present.

● THE BUREAU OF FOREIGN AND DOMESTIC COMmerce of the United States Department of Commerce has announced that a new order pertaining to the plastics industry has been put into effect in England. The order which came into force on October 1, 1940, and is known as "The Control of Plastics (1) Order, 1940" states that plastics in the form of molding powder in the production of which any certain raw materials have been used may not be bought, sold or used except under license. Raw materials mentioned in the order are formaldehyde, phenol, cresol, thio-urea and cellulose acetate. The Ministry of Supply has also appointed a Controller of Plastics.

● THORNTON C. JESDALE, ASSISTANT MANAGER OF the Chicago branch office of Monsanto Chemical Co., has been transferred to the Everett, Mass., office where he is now in charge of New England sales of the products of the Organic Chemicals and Phosphate Divisions.

● IT IS REPORTED THAT THE GLYCO PRODUCTS CO., Inc., has approved plans for its new building in Brooklyn, N. Y. This will consist of three sections, the administrative, research laboratory and manufacturing divisions. The research laboratory will include additional pilot plant and pilot auxiliary equipment. Exceptionally high head room for the manufacturing unit will make possible the installation of specially designed refluxing and distilling units, it is said. The administration building and research laboratory will be located at 228–236 King Street, and the shipping and receiving departments will be at Pioneer Street. It is anticipated that operations will be commenced on or about December 15, 1940.

● THE EXTENSION DEPARTMENT OF McGILL UNIversity, Montreal, Canada, announces a 12-hour lecture course on the chemistry and technology of resins and lastics. This evening course is being offered for the third successive year to college and industrial chemists as an extension to a course on resins that is given to the university's undergraduates in the Department of Chemical Engineering. The lectures will be illustrated with material from the department's comprehensive collection of synthetic resins, it is reported.

● CONSOLIDATED PRODUCTS CO. GAVE A TESTImonial dinner to B. M. Todd, superintendent of the company's Newark warehouse, upon his retirement after 21 years of service, it has been announced. Mr. Todd is said to be the first employee of the firm to receive a pension.

● EUGENE R. PERRY HAS BEEN PROMOTED TO manager of engineering and superintendent of the Micarta works of the Westinghouse Electric & Manufacturing Co. at Trafford, Pa., it was recently announced by G. S. Ryan, manager of the Company's feeder division.

● DOALL SAWS, INC., ANNOUNCES THE OPENING OF a new factory in Des Plaines, Ill. The new enlarged building contains over 15,000 sq. ft. and is devoted to the production of narrow precision band saws for cutting metal.

● A MEETING OF THE AMERICAN SECTION OF THE Society of Chemical Industry, jointly with the American Institute of Chemical Engineers, was held on November 15. The subject of the meeting was "The Science and Application of Plastics." Dr. T. F. Bradley of the American Cyanamid Company presented the chemistry of plastics and C. W. Blount of the Technical Sales Division of Bakelite Corp. discussed the scope of their application. *(Please turn to next page)*

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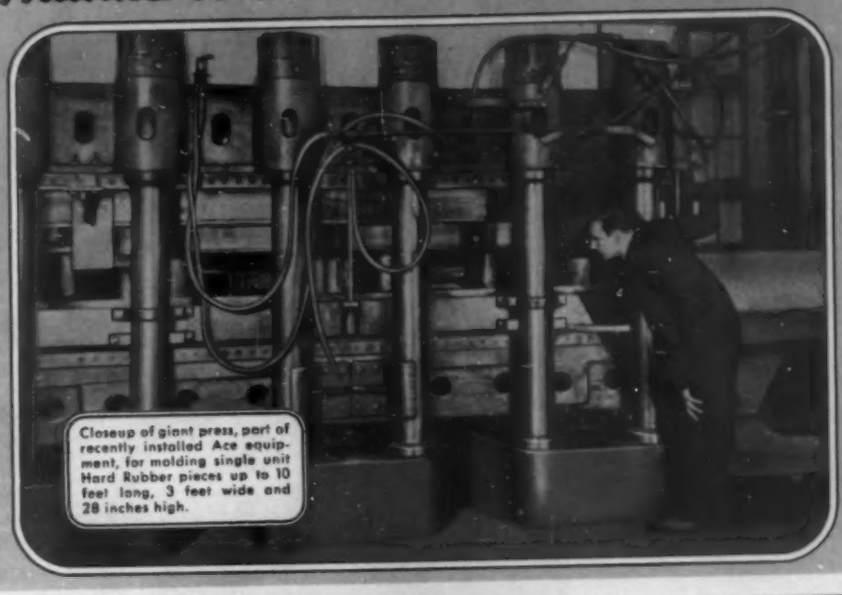

Closeup of giant press, part of recently installed Ace equipment, for molding single unit Hard Rubber pieces up to 10 feet long, 3 feet wide and 28 inches high.

GIANT one-piece moldings in Hard Rubber are now available for industrial uses. Ace has made this possible through new molding techniques, ingenious equipment. Ace engineering, design and laboratory staffs are prepared to plan and produce Hard Rubber articles of unusually large size.

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Carboys — Drums — Tank Trucks — Tank Cars

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Fine white color and complete solubility

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Granular and Powder • U. S. P. and Technical

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Purified and Technical
A white, crystalline powder, non-toxic and conforming to standard specifications.

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CHICAGO BRANCH: 180 N. WACKER DRIVE
FORDS, NEW JERSEY

● UNION CARBIDE AND CARBON CORP. ANNOUNCES that ground has been broken for a new building at Bakelite Corp.'s plant in Bound Brook, N. J., for the production of *Vinylite* plastic materials. Construction will be started in the very near future. The building will be approximately 500 ft. by 250 ft. in size.

● A SAMPLE KIT ON PLEXIGLAS AND CRYSTALITE has been prepared for distribution to recognized designers by Röhm and Haas Co., Incorporated. The portfolio, which is file size and tabbed for easy identification, contains samples of transparent and translucent sheet stock in various thicknesses and densities, as well as samples of deep colors and tints, molded pieces, bars and a straight and curved rod. Data sheets and a booklet on properties and applications of the material are also included. Address requests to the company at 222 West Washington Square, Philadelphia, Pa.

● ANNOUNCEMENT IS MADE BY WARWICK CHEMICAL Co. of West Warwick, R. I., that Dr. Dale S. Chamberlin, vice president of the company, has assumed the duties of Sales Manager of the Stearate Division. Dr. Chamberlin has had industrial chemical experience with several well-known firms and has been vice president and Chemical Advisor of the Warwick Chemical Co. since 1935.

● APPOINTMENT OF DONALD S. McKENZIE (ABOVE) as sales manager of the Plastics Department of the General Electric Co. has been announced by Manager G. H. Shill. McKenzie, who will be located in the department's headquarters at Pittsfield, Mass., succeeds W. H. Milton, Jr., who recently was named assistant manager of the department. McKenzie comes to his new position from Cleveland where he has been affiliated with the Nela Park division in the Sales Fluorescent Sign Tubing and Fused Quartz Department.

● THE DEVELOPMENT OF A TERPENE POLYMER resin known as Nypene resin is announced by the Neville Co., Pittsburgh, Pa. The resin is said to have a melting point of 140 to 150 deg. C., pale color and is neutral and non-saponifiable. Claimed to have good resistance to water, acids and alkalies, the resin is compatible with paraffin, natural and mineral waxes and Vistanex polybutene. One of its most interesting properties is its softening action on rubber.

● NELSON HUNTLEY, PRESIDENT OF H & H Research Co., Detroit, announces the appointment of the Detroit International Trading Corp., 544 Insurance Exchange Bldg., as their exclusive export agent.

VALDURA FLOOR SEALER, A NEW FORMULATION for treating unfinished wood floors has been developed by American Asphalt Paint Co., 43 East Ohio St., Chicago. This product is said to protect against dirt, water, grease and constant wear and to produce a waxed, polished surface with no surface coating to wear off. It is transparent and does not change the original color of the wood.

● NILS ANDERSON, JR., HAS ANNOUNCED HIS RESIGnation from the Bakelite Corp. and his new business address at Debevoise-Anderson Co., Inc., 114 Liberty St., New York City.

● SINKO TOOL AND MFG. CO., CHICAGO, ILL., announce the appointment of L. D. Moore as its representative in the territories of southern Illinois, Missouri and Kansas.

● THE 1940 ANNUAL MEETING OF THE AMERICAN Society of Mechanical Engineers was held at the Hotel Astor, New York City, from December 2 to 5. A series of inspection trips to local industrial plants and special building projects of interest to mechanical engineers high-lighted the meeting.

● ANNOUNCEMENT HAS BEEN MADE OF THE OPENing of a Plastics Coating Division by the Gemloid Corp., 7910 Albion Ave., Elmhurst, L. I. This department which is under the supervision of Ralph Bretzner will be located in Brooklyn, N. Y. One of the new trade names to be used by the firm will be *Gem-Cote*.

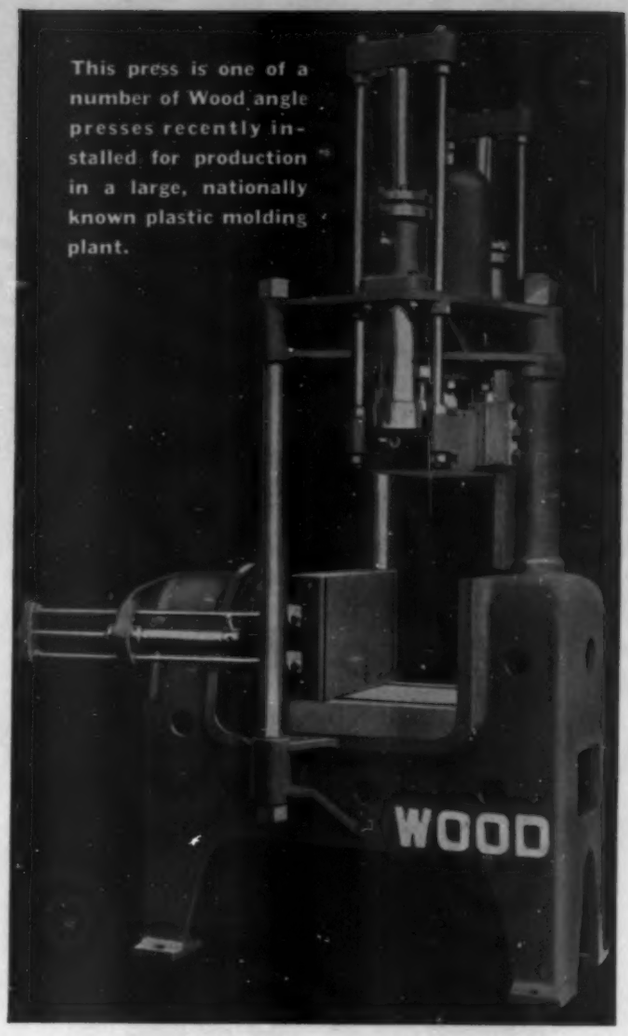
● DESIGNED TO SIMPLIFY THE JOB OF THE NATION'S tool engineers in connection with tooling up for National Defense the 1941 Machine and Tool Progress exhibition, scheduled for the week of March 25th in Detroit's Convention Hall will be confined to the latest developments in the way of equipment, processes, tools, materials, etc., available for speeding up defense production.

Sponsored by the American Society of Tool Engineers, the show will be strictly educational in character. According to Frank Shuler of the Chrysler Corp., and Chairman of the Show Exhibit committee, the exhibition will enable the men responsible for specifying and selecting equipment for National Defense work to view under one roof many of the most recent developments designed to expedite defense production.

● THE APPOINTMENT OF HERBERT A. T. SMITH AS production manager of the Manufacturers Chemical Corp. has been announced. Smith, formerly associated with George H. McFadden & Brothers, cotton brokers, has been closely associated with textile mills, producing both synthetic and cotton materials, it is said.

● CHICAGO WILL BE THE TEMPORARY CHEMICAL capital on December 11 to 15 with the holding of the first biennial National Chemical Exposition and Industrial Chemical Conference at the Stevens Hotel under the auspices of the Chicago Section of the American Chemical Society. More than 20,000 are expected to come from all sections of the country to view the show and participate in the conference which will be addressed by several noted authorities.

● E. I. DU PONT DE NEMOURS & COMPANY HAS started construction of a further addition to the Neoprene plant at Deepwater Point, N. J. These new facilities are expected to be completed in October 1941. They will supplement a plant addition of the same size which has just been finished. Together, the two latest additions to the plant will increase its capacity by one million pounds per month, raising the total production facilities to one and one-half million pounds per month, six times the capacity available in the summer of 1939.


This press is one of a number of Wood angle presses recently installed for production in a large, nationally known plastic molding plant.
WOOD

...WOOD ANGLE MOLDING PRESSES

Units like the one shown above, as well as other WOOD presses in a variety of sizes and capacities, play important parts in the production of molded plastics.

The experience of R. D. WOOD engineers is available to you at all times for consultation on hydraulic press and valve requirements.

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THE BEAD CHAIN MANUFACTURING CO.

*Reg. U. S. Pat. Off. 60 MT. GROVE ST., BRIDGEPORT, CONN.

Plastics for fluorescent lighting

(*Continued from page 33*) For purposes in which it is desired to cut glare from all directions to the normal field of vision, one smooth-surfaced sheet may be used on top of another, with the louvers forming an egg-crate pattern.

Another innovation is a sheet combining clear transparent plastic with colored louvers, making possible color in fixtures which direct softly diffused light toward the eye, while shedding white light on the objects which it is desired to illuminate. There is no appreciable loss of lighting efficiency, as all but the light at wide angles of the generated light is through the clear transparent sections. When two sheets, each with louvers of a different color, are used to make an egg-crate pattern, the sheeting color appears to change in eye-catching fashion as one moves about it. Of special interest is the kind with pink louvers. This type reduces the unflattering and off-tint appearance given by fluorescent lamps to objects of reddish and brownish hues because of the insufficiency of red light afforded by "3500 white" lamps. The pink louver material is expected to enter especially into food and other display use, and into fixtures for night clubs, hotels, etc., where distorted appearance because of unusual lighting effects is taboo. Sheeting with black louvers, with which only direct light transmission is retained, also has specialized use. Theatre aisles, hospital corridor and room lights, elevator, staircase, exit, and picture frame lights are among potential applications, in addition to special lighting fixture use. The black type will undoubtedly find extensive application purely for purposes of vision control.

This louvered sheeting lends itself to dust-tight fixtures, an important consideration in the transportation field. Easy workability, with characteristics in this and other respects much the same as those of other types of cellulose acetate sheeting, is also held an advantage in its adaptation to lighting fixtures, display use and other fields. The sheeting is made in .040 in., .060 in. and .080 in. thicknesses, the deeper louver of the thicker sheets giving a smaller angle of cut-off. The clear transparent strips, separated by the louvers, are .040 in. wide. There are 24 louvers per inch. Widely spaced louvers only partly fulfill the requirement of shielding the tube, because unless there is complete cut-off by the louvers, portions of the lamp are visible at full brilliancy, causing eye discomfort. The minute louvers of these sheets give a complete cut-off, coupled with high transmission of direct light. A balance of transmission efficiency in useful directions and light interception in harmful directions is thus achieved, which produces the eye comfort with fluorescent lighting in a new way.

A manufacturer of lighting equipment in the transportation field claims that their requirements as far as plastics are concerned are threefold: light transmission, diffusion of visible color and brightness contrast, and stability with age, changing temperatures, and radiation influences. Quite frankly, this company admits that these requirements are demanded to protect them and their lighting activities from plastics that might be advocated for use in connection with fluorescent lighting but are not suited to withstand the service conditions. For this firm's particular applications, either an acrylic plastic or vinyl chloride-vinyl acetate-copolymers base with suitable fillers for diffusion and translucency has proved best. Their requirements demand at least 68 percent transmission of incident light through a plastic sheet .060 in. thick. Other demands that these types of plastics are asked to meet in connection with fluorescent lighting are: not more than .01 in. change per ft. in length or width for each 18 deg. F. change in temperature; very slow burning rate and no support for combustion; an absence of expansion, contraction or warpage in variable atmospheric

14—*Throughout the B. A. Sellars & Sons department store in Burlington, N. C., fluorescent fixtures by the Miller Co. are used. Diffusing shields are Monsanto embossed cellulose acetate.* **15**—*Millions of molded and laminated auxiliary parts are turned out each year with production steadily increasing*

14

15

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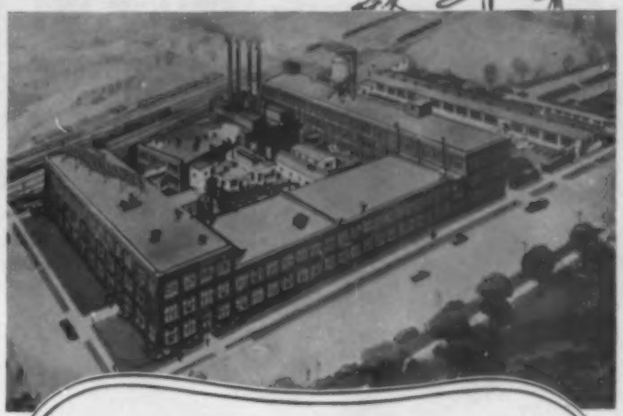

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conditions from practically zero to 100 percent humidity; no change in color or light transmission from exposure to temperatures under 170 deg. F.

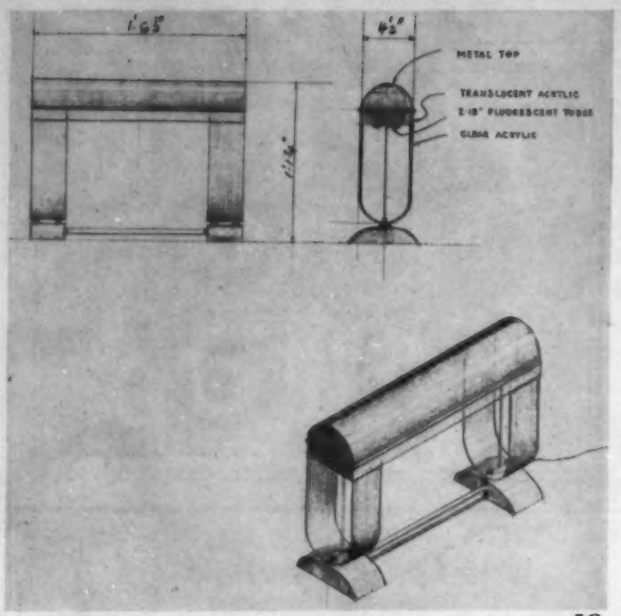
The following table shows the reflection and transmission factors of 24 samples of white diffusing acrylic plastic in various densities and thicknesses. The figures under the heading, *No.*, refer to various densities of opacity.[4]

	No.	Transmission Factor	Reflection Factor
5 Samples			
6 in. by 6 in. by .060 in.	122- 50	.68	.28
	125	.61	.36
	250	.54	.43
	500	.46	.50
	1000	.37	.60
5 Samples			
6 in. by 6 in. by .100 in.	122- 50	.63	.33
	125	.55	.42
	250	.46	.49
	500	.37	.59
	1000	.26	.68
5 Samples			
6 in. by 6 in. by .125 in.	122- 50	.60	.34
	125	.52	.44
	250	.43	.52
	500	.32	.62
	1000	.23	.71
5 Samples			
6 in. by 6 in. by .187 in.	122- 50	.53	.41
	125	.47	.48
	250	.37	.57
	500	.25	.68
	1000	.17	.76
4 Samples			
6 in. by 6 in. by .250 in.	122- 50	.53	.37
	125	.44	.49
	250	.34	.60
	500	.22	.71

Remarks: Reflection Factors determined by integrating totally reflected light from direct incident light at 30 deg. to normal of marked side of sample. Transmission factors determined by integrating total transmitted light from diffuse light incident to marked side of sample.

[4] Data submitted by Röhm & Haas Co., Inc.

A wide variety of auxiliary parts such as sockets, starter housings, socket crowns or end caps, fronts, backs and covers for starters, base insulators, lamp holder covers, and starter insulators are being made of plastics. Phenolic, urea and styrene plastics are being employed for molded socket crowns, starter housings and the like, while phenolic laminated sheets are providing the insulating qualities needed for the stamped parts. These pieces of fluorescent equipment were quite naturally made of plastics from the very beginning; in other words, plastics are not replacing other materials for these parts, except, perhaps, porcelain in a few isolated cases. One molder reports that, in a period of 8 months, they turned out nearly 15,000,000 molded parts and more than 25,000,000 laminated pieces for fluorescent equipment. Add this to the quantities of translucent laminated stock that this company supplies to fluorescent equipment manufacturers, and it is evident that this field is worthy of serious consideration.



16

17

16—*A fluorescent fixture designed by Paul Cret combines clear and translucent Plexiglas with metal.* **17**—*Color and design are a matter of taste on this display sign housing an 18 in. lamp. J-Lite (Pat. pending) has a metal base with an Insurok shield*

The growth of popularity for fluorescent lighting has been amazing. Available less than 100 weeks, production is already geared up to a pitch that will be able to care for anticipated sales of 20 to 25 million lamps per year. New developments and constant improvement is the order of the day, as evidenced by the 100 watt, 60 in. lamp that recently made its debut. This lamp has twice the light output per ft. length of the 40 watt, 48 in. lamp. The introduction of this longer lamp greatly increased the scope of applications for fluorescent lighting, since larger rooms with high ceilings can now be illuminated by fluorescent light without making the total number of light sources too numerous. New possibilities have been opened up in the residence field by the introduction of the new 6 watt lamp. Measuring 9 in. in length with a diameter of $^5/_8$ in., this lamp is ideal for home use. Such developments are characteristic of the constant advancement and progress in the fluorescent lighting field.

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Phenolic asbestos equipment

(*Continued from page 57*)

changeable 6 in. squares. With this mold, it is possible to produce any outside dimension, length, width or depth, provided that it is a multiple of 6 in. The inside dimensions of the standard tanks vary, of course, depending on the wall thickness. Wall thicknesses on rectangular tanks vary from 1/2 in. to 1 in., as shown in Fig. 8. Shallow tanks up to 12–18 in. need no support, but for long and relatively deep tanks, a support structure is used to prevent permanent deformation. The structure consists of a set of steel ribs, bolted around the tank. The number of ribs required for a given tank size is shown in the table.

Example 1.—Tank 2 ft. 6 in. by 4 ft. by 1 ft. From the table, wall thickness = 1/2 in., bottom thickness = 5/8 in. Outside dimensions are as given above. Inside dimensions are 2 ft. 5 in. by 3 ft. 11 in. by 0 ft. 11 3/8 in. With this depth, no ribs are required for support.

Example 2.—Tank 6 ft. by 5 ft. by 4 ft. deep. From the table, wall thickness = 5/8 in., bottom thickness = 3/4 in. Inside dimensions are 5 ft. 10 3/4 in. by 4 ft. 10 3/4 in. by 3 ft. 11 1/4 in. Tank will require 5 support ribs.

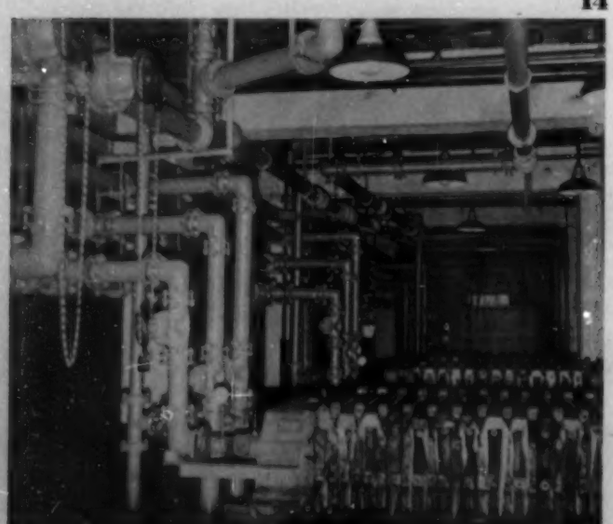
Figures 9 and 10 show rib structure on two typical rectangular tanks.

One-piece rectangular tanks can be made up to a maximum of 10–13 ft., depending on the diagonal of the cross section. Very frequently, however, tanks are required considerably longer than this, especially for continuous pickling service. This is accomplished by bolting several sections together. There are several methods of doing this, the most common being a simple flange construction such as shown in Fig. 11. The design of each individual section of such a tank is exactly the same as a one-piece tank.

(*Please turn to next page*)

14—*Installation of 2 in. and 4 in. pipe and valves in an eastern chemical plant is shown below*

14



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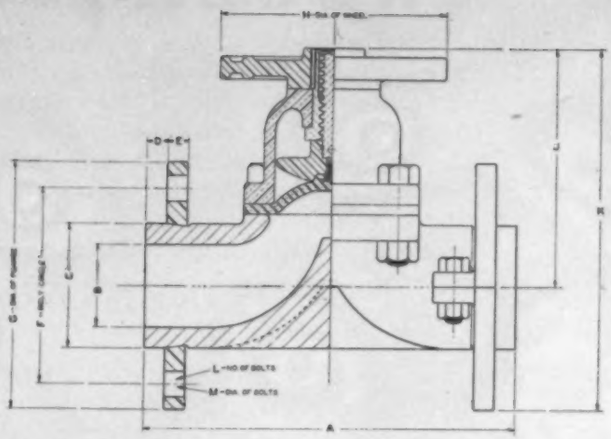


15—*Illustrated above is the basic design drawing of Haveg-bodies Hills-McCanna-Saunders patent diaphragm valves.* **16**—*(Below)—design data of fume duct and fittings made of phenolic asbestos material is shown in diagrammatic and tabular form*

16

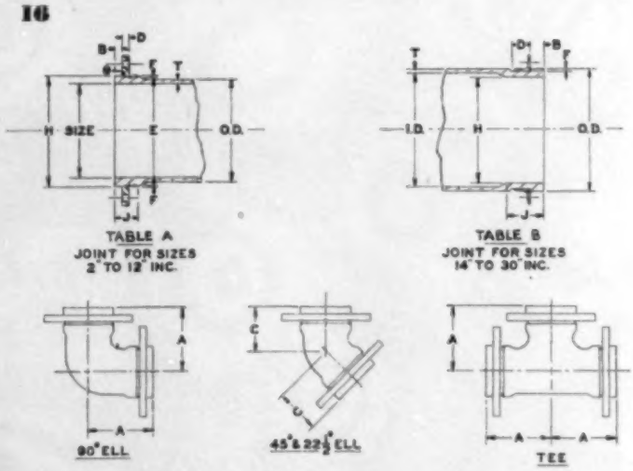
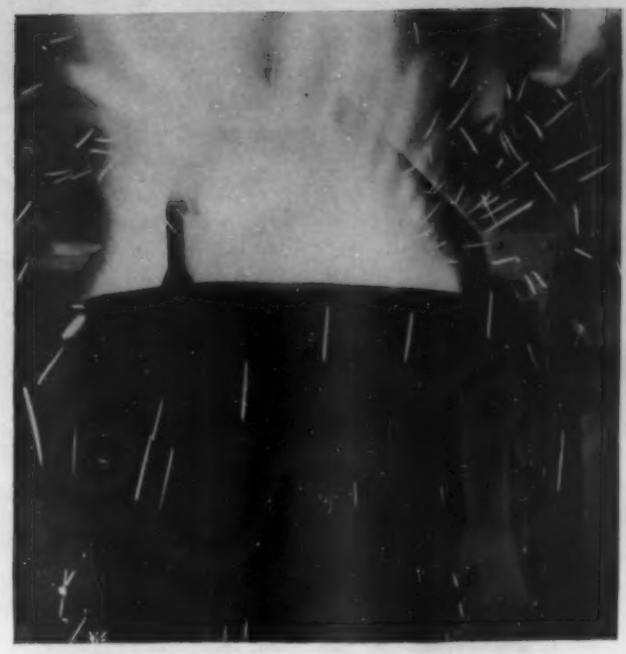


Table (A)

Size	O.D.	T	DUCT							FIT-TINGS		FLANGES			BOLTS	
			B	D	E	F	O	H	J	A	C	O.D.	Thick	B.C.	No.	Size
2	2 3/4	5/8	1 1/2	1 1/2	2 7/8	1/4	7°	3	1 1/2	4 1/2	3 1/4	6	1/2	4 3/4	4	3/4 × 3
3	3 3/4	5/8	2 1/2	2 1/2	4 1/4	1/4	9 1/2°	4 1/2	2	5 1/2	3 3/4	7 1/2	5/8	6	4	3/4 × 3 1/4
4	4 3/4	5/8	3 1/2	3 1/2	4 1/2	1/4	14°	5 1/2	2	6 1/2	4 1/4	9	5/8	7 1/2	4	3/4 × 3 1/2
5	6	1/2	4 1/2	4 1/2	6 1/4	1/4	14°	6 1/2	2	7 1/2	4 1/2	10	5/8	8 1/2	4	3/4 × 3 3/4
6	7	1/2	5 1/2	5 1/2	7 1/4	1/4	14°	7 1/2	2	8	5	11	5/8	9 1/2	4	3/4 × 3 3/4
8	9	1/2	7 1/2	7 1/2	9 1/4	1/4	14°	9 1/2	2 1/2	9	6 1/2	13 1/2	3/4	11 3/4	4	3/4 × 4 1/4
10	11	1/2	1	9 1/2	11 1/2	1/4	14°	12	3	11	6 1/2	16	3/4	14 1/4	6	1/4 × 4 3/4
12	13	1/2	1	11 1/2	13 1/2	1/4	14°	14	3	12	7 1/2	19	7/8	17	6	1/8 × 5

Table (B)

Size	I.D.	O.D.	T	DUCT					FIT-TINGS		FLANGES			BOLTS	
				B	D	F	H	J	A	C	Size	I.D.	B.C.	No.	Size
14	14 1/2	16 1/2	1/2	1 3/4	2 1/4	1/4	13 1/2	4 3/4	20	14	2 X2 X1/4	14 7/8	17	8	1/2 × 4 3/4
16	16 1/2	17 1/2	1/2	1 3/4	2 1/4	1/4	15 1/2	4 3/4	22	16	2 X2 X1/4	16 7/8	19	8	1/2 × 4 3/4
18	18 1/4	19 1/4	1/2	2	2 1/4	1/4	17 1/4	5	24	18	2 X2 X1/4	18 5/8	20 1/2	10	1/2 × 5 1/2
24	24	25 1/2	5/8	2	2 1/4	1/4	23	5	30	22	2 X2 X1/4	24 1/2	26 1/2	10	1/2 × 5 1/2
30	30 1/4	31 1/2	5/8	2 1/2	2 3/4	1/4	29 1/4	6	34	28	2 1/2 X2 1/2 X1/4	30 3/4	33 1/2	12	1/2 × 6 1/2



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Pipe and fittings are available in standard sizes ranging from 1/2 in. to 12 in., and to even larger sizes on special applications. For connection, a split cast-iron flange is set in a tapered slot machined near the end, with a gasket between the pipe ends. Details of the pipe and the method of connection are shown in Figs. 12 and 13. It should be noted that bolt circles follow A. S. M. E. Standards.

The wall thicknesses of phenolic-asbestos pipe are determined mainly by manufacturing considerations, the strength of the material for all sizes being considerably greater than the service recommendations require. Bursting tests on most sizes give results 10 to 15 times as high as the usual recommendations. With regard to the allowable pressure, there are several installations which have been in service for several years at

17—*Installation of Haveg floor covering cemented in place*

60 lb. per sq. in. While slightly higher pressures than this would probably be entirely safe with the smaller pipe sizes, the writer regards a figure of 60 lb. as a good sound maximum. In laying out pipe lines, it is unnecessary to figure accurately the exact length of every piece ahead of time. The pipe can be cut off to exact length in the field, and the end can then be machined in an ordinary lathe. For valves, the usual construction employed is the Hills-McCanna-Saunders patent valve with Haveg body (Fig. 15). This construction employs a rubber or composition diaphragm which effectively seals the working parts from the corrosive liquid. Plug cocks, plug valves and other types of valves are also made.

Fume Duct

For handling or disposing of noxious gases and acid fumes, a standard series of light-wall fume duct is available, in sizes up to 30 in. This duct is not intended for use where the pressure is more than a few inches of water. It is usually supplied in a flanged construction (Fig. 16), but can also be made with bell ends where this is any advantage. In the preceding discussion of design details for a few illustrative types of equipment, the use of the so-called Haveg "41" was postulated. This grade, for use mostly under acid conditions, is by far the most commonly employed. It was pointed out, however, that two other grades are available for other chemical services. The design for the other grades, while following exactly the same principles, is different in details and warrants brief discussion.

Haveg "43," for use with hydrofluoric acid, has about the same tensile and transverse strength as Haveg "41"; but it has a very much lower resistance to shock and can be broken by a moderate blow. It is usually limited in size to about 4 ft. as the maximum dimension. Up to this limit, the wall thicknesses are 50 percent greater than Haveg "41," and the supports are the same. Because of its relative fragility, Haveg "43" is practically never used except with hydrofluoric acid and related compounds.

Haveg "50" is based on a somewhat different type of resin and has resistance to strong caustic as well as to acids. Its resistance to shock is excellent—even better than Haveg "41." Its physical strength is somewhat less, however, and it is softer and more liable to permanent deformation in the absence of support. In terms of design, this means that while the same wall thicknesses are used as with Haveg "41," even relatively small equipment produced from Haveg "50" should be given full external support. The latter material is a relatively new development, having been used commercially for about three years. Up to the present, the largest equipment that has been produced from this grade consists of tanks, about 5 ft. diameter by 5 ft. deep. It is, however, undoubtedly practical for even the larger sizes, with adequate attention being paid to support.

Before concluding, two other modifications of resinous compound which are being applied industrially should be mentioned. The first is a cold-setting acid-resisting cement, compounded from a phenolic resin and various fillers. It is hardened in place by the addition of an acid hardening agent and is widely used for cementing acid-proof brick or tile linings and for similar purposes. The second is the application of a special sheet composition to floor covering to protect existing floors from chemical corrosion (Fig. 17). The material is produced in standard sheets which are cemented in place over the old floor. The cement has the same chemical resistance as the covering and effectively seals the joints. This floor covering is, so far as the writer is aware, the newest industrial application of phenolic type compositions. It has been in use about a year and the service has indicated that the material has the necessary toughness to withstand at least normally abusive plant conditions.

In conclusion, the writer ought to point out that in this short discussion it has been possible to cover only the general considerations affecting design of industrial phenolic-asbestos compositions, with specific details in only two or three cases. It is hoped, however, that even this brief survey may have provided the designing engineer with sufficient information to permit proper selection of applications and grades, and with enough design data so that he may either work out the simpler constructions himself or criticize more intelligently designs which may be submitted to him.

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But as the above photographs indicate, the making of such an intricate mold in this large size presented unusual difficulties. There was the ever present problem of finish, on which sales of the washer might stand or fall. There was the relatively thin insert on the upper half. There was an exceedingly stiff requirement for dimensional accuracy. There was the problem of achieving sufficient hardness for long runs, plus the problem of getting enough toughness in the core to prevent upsetting.

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Flow temperature of thermoplastic materials

(*Continued from page 61*) mined by the modified Dillon extrusion plastometer for groups of materials of similar composition. The data available show deviations of approximately ±10 deg. C. from the overall average curves drawn as straight lines with slopes of unity and expressed as:

Flow temperature = relative plasticity −3 deg. C.

and

Flow temperature = extrusion temperature −28 deg. C.

However, it is possible that when more information is available, the curves for widely different plastic types might be found to differ somewhat from those given in slope or even in shape.

No simple correlation is suggested between the plastic temperature as determined with the modified Williams parallel-plate plastometer and the data determined by the other methods except in special cases. It is possible that with groups of materials quite similar in composition, correlations can be established.

Not all types of thermoplastic molding materials were tested nor was a sufficient number of plastics of each type tested. All of the experimental values except those obtained with the Rossi-Peakes flow tester were determined on only one machine so that the accuracy of the machines or methods is not apparent.

This investigation has shown that several methods of determining plasticity or flowability at molding temperatures give comparable results when temperature is the variable. Considerably more work, both on materials and methods, is necessary before accurate correlations can be expressed.

Acknowledgment

This paper has been made possible by the cooperation of (1) R. A. Boyer of Ford Motor Co., J. H. Adams of Bakelite Corp., D. L. Gibb of Dow Chemical Co., and L. W. A. Meyer of Tennessee Eastman Corp. who ran tests with the Rossi-Peakes flow tester; (2) Bjorn Andersen of Celluloid Corp. who ran tests with the Mooney shearing disk plastometer; and (3) L. M. Currie and M. C. Reed of National Carbon Co. who ran tests with the modified Dillon extrusion plastometer and with the modified Williams parallel plate plastometer.

Materials were furnished by Carbide and Carbon Chemicals Corp., Celluloid Corp., E. I. du Pont de Nemours and Co., Monsanto Chemical Co., Dow Chemical Co., and Tennessee Eastman Corp.

Oh, you beautiful doll!

(*Continued from page 35*) dolls' heads by the thousands are now in production using this plastic.

Constructing molds for a complex surface such as a doll's face is a problem. Routine designing of molds is impractical. It is impossible to record on paper the physiognomy of a head. Therefore, it was necessary to prepare three-dimensional, scale models from which all the molds were constructed. Several methods for making the molds were tried, including casting beryllium copper. Indications are that the optimum results are obtained in resorting to the standard technique of hobbing. The production dies have both the face and the back of the head incorporated in one casting. For molding reasons the thickness of the material has been varied from one part of the cranium to the other.

As the heads are removed from the injection machines, the gates and sprues are removed, the flash is trimmed off and the two halves are cemented together. This operation requires careful control. With the large diameters involved, and with the molded parts flexing as they do, caution must be exercised to obtain a good register between the two halves to insure the cement holding at all points of contact.

After the heads have been assembled the delicate manufacturing process of finishing is next in line. First by a wet-sanding operation all rough surfaces are removed. The heads are then inspected and given an additional hand finishing. The next series of operations, not less than 12 in all, is where the doll's head receives its egg-shell complexion. Had there been no thorough investigation of this phase, there would be no injection molded dolls' heads. Lacquers had to be developed which, when they were applied, became permanently fast and hard. To be successful, no tackiness could develop and no migration of color was permissible. Through making various accelerated tests, by switching and substituting types of lacquers and materials, a solution was found to this problem. Practically every step in the decorating operation is done by hand. Through the skilled work of craftsmen, unassisted by stencils, eyelashes, eyebrows, lips and hair are applied.

Probably no part of a doll is more important than its eyes. They are ostensibly simple things, easily made and readily installed. Actually, they are both intricate and complex. Incidentally, they have given the patent office something to do. One company has over 50 patents on dolls' eyes alone! Plastics are extensively used in manufacturing dolls' eyes, and manufacturers have not confined themselves to one type of material. Pyroxylin is widely used, because it makes an attractive, serviceable eye. Sheet stock is formed into a hemispherical shape, then tinted to resemble the cornea. A contrasting color is inserted for the pupil. Methyl methacrylate materials because of their splendid clarity and their high light refractive index are now being used. The process for making eyes with them is much the same. Because the injection molded heads are held to close tolerances and since there is slight deviation from one to another in production assembling the eye unit is an easier operation than with a woodflour head.

The injection molded cellulose acetate dolls' heads have many outstanding qualities. The method alone makes it possible to reproduce lifelike fidelity of feature. Hair curls, nostrils, ears and other facial details are more realistic. A plastic head weighs up to ½ lb. less than the ordinary wood composition depending upon size. Dolls assembled with these heads are lighter than others by nearly one pound. Perhaps nothing is more important than their non-breakable quality.

Production on the head of one size has been, well beyond the limits of a pilot quantity. Plans are under way for tooling additional others.

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Molding lenses

(*Continued from page 37*)

It must be understood that the foregoing review of plastic lens manufacturing is the opinion of one person and a great many variations can be made to the procedure with equally good results. We are giving here the experiences which resulted in the successful manufacturer of plastic lenses. We will also cover as many experiences as possible that proved to be mistakes. It is our hope that it will be helpful to those interested and will foster new ventures in the plastic industry.

Methods of molding

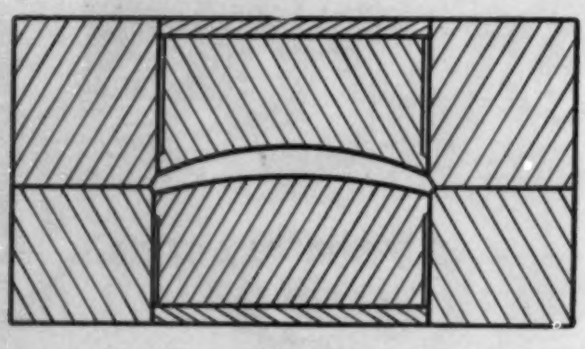
There are two fundamental methods of producing plastic lenses. The compression method and the injection method. Each has its advantages and its disadvantages. The injection method is by far the speedier of the two. For lenses of the best optical qualities the compression method should be used as a much harder material can be used and the lens surface is almost free from the minute waves which are always evident on the injected molded lens. Furthermore it is very difficult to eliminate striae in the injection molded lens, and this is not found in the compression molded lens when molded under proper conditions. The most important disadvantage in the compression job is the necessity of having to remove the flash around the periphery of the lens. The operation in itself is not so difficult, but due to the fact that methyl methacrylate materials are magnetic, the trimmings have a tendency to stick to the lens and it is difficult to clean the lenses after the finishing operation without scratching the surface. The removal of the gate on the injected lens is much simpler.

Equipment

It has only been in the past year that the equipment manufacturer has designed his injection equipment for the higher pressures. Higher pressures has been the topic of discussion among the molders for some time. It was not until some of the molders rebuilt their equipment that the manufacturer took notice that higher pressures were really desired and found absolutely necessary. It is a proved fact that pressures above 30,000 lbs. per sq. in. on the material in the cylinder are required to mold lenses by injection, and 6000 lbs. per sq. in. or more are required for compression molding. The best lenses that have been produced today have been molded by injection with pressures of 50,000 lbs. per sq. inch.

From the above, it can be concluded that the equipment for lens production must be of the latest design or rebuilt to give the desired pressures. This is not true of compression presses as the number of cavities can be limited according to the size of the press to get the required pressure on cavities. (*Please turn to next page*)

1



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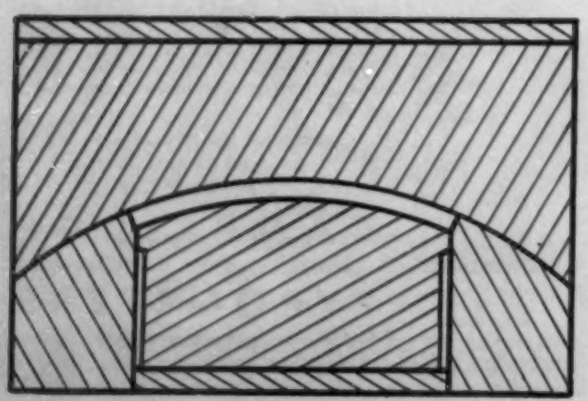

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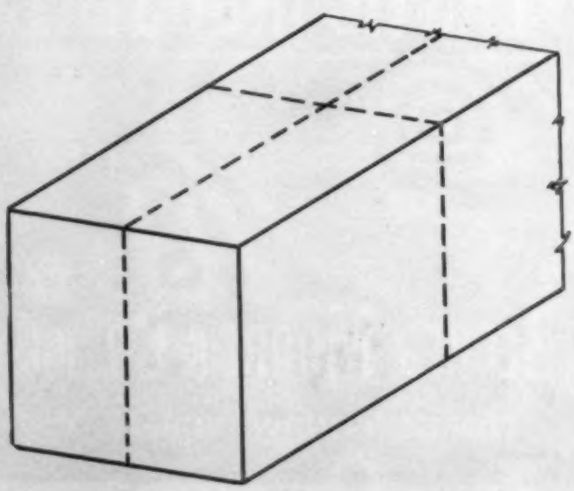

1—Drawing illustrates cavity construction showing inserts and shims. 2—Another diagram on the cavity construction shows the top half of the cavity in one piece. Shim shown at the top is required. 3—The forged bar should be cut through the center as indicated by the dotted line and these surfaces used for the back side of the insert. The polished surfaces should be cut on outside surface of the bar

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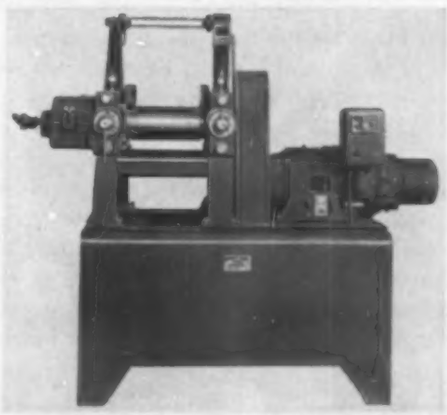

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Molding materials

Materials for the plastic lens are confined to three types named in order of their preference: methyl methacrylate, polystyrene and cellulose acetate. The first two are superior as far as clarity and light transmission properties are concerned. The only advantage of the acetate lens is a higher shock resistance. The material suppliers have been through a great deal in the past two years in perfecting their materials for lens production to meet the requirements of the customer and the molder. We will not go into the various phases of formulation of the materials for lens requirements as it is a study in itself and needless to say the material suppliers have the problem constantly before them and changes are being made in materials almost daily. The material supplier should be consulted on all applications for plastic lenses.

Mold design

In general the design is in keeping with general practice. Due to the high pressures used the design must be rugged and well supported to assure rigidity. Any flexing or misalignment in the mold caused by the high pressure results in lenses of varying optical properties.

The most important phase in the design is the method of producing the inserts or the parts of the mold which form the polished surfaces of the lens. There are two methods of producing these inserts, one by an electroplating process and the other by machining the inserts from a solid piece of tool steel. The first method is unsatisfactory for a production mold as the inserts made in this manner cannot be hardened to any degree that will withstand the high pressures. The electroplating method was first used for lack of a better method. It gave the desired results in that a surface could be produced that was reasonably free from porosity and with a finish that required no further optical polishing. This method, even though inexpensive as far as the initial investment is concerned, requires frequent replacement of the insert. To find a steel that answered all the requirements from which these inserts could be machined was not an easy matter. The requirements of a steel for this purpose are: to be machinable, susceptible to heat treatment, to give a uniform hardness throughout the piece, ability to take a high polish, to be noncorrosive. Most important it must be absolutely free from porosity. Numerous steels were investigated and it was found that a high-grade stainless steel would meet all the requirements. Steels have to be ordered from selected stock and in square or rectangular forged bars. Round bars should not be used as they cannot be forged to the same density as square stock.

In selecting the bar sizes, the method of cutting the blanks from the bar has to be taken into consideration. It is necessary to stay away from the center of the bar for the polished surfaces of the inserts. The polished surface should be as near with the grain as possible. Consequently the bar width should be such that it will permit the blanks to be cut so that the center of the bar forms the sides opposite the polished surfaces.

Due to the fact that in grinding and polishing the insert surfaces it is difficult to keep the tangent of the curve at the center line parallel with the back surface of the insert, provisions have to be made to take care of any discrepancy in the grinding and polishing operations. This difficulty in the grinding and polishing arises from the method used to do this work in that a satisfactory polishing job is accomplished only by means of a floating fixture. Consequently there is no mechanical control over the amount of metal that is polished off the insert, with the result that more metal is taken off on one side than on the other with no certainty of which side. This discrepancy is very slight if any, but if extreme, it would throw off the optical properties of the lens. The method of correction is to cock the insert in the cavity and provide shims of at least one-eighth inch thickness which can be ground at an angle to assure the proper position of the insert in the cavity. It might be concluded that the insert could be ground on the back side to correct any errors in the polishing operation. It must be remembered that after the inserts are polished, the surface cannot be touched, let alone using any emery anywhere near them. All fitting of the mold must be done before polishing and the inserts are merely set into place during the assembling operation.

For the injection mold the gate and sprue design are important. The gates should be as short as possible and larger than usual. There should be the cavity for the "cold slug" with sufficient space for all the cold material in the nozzle. The gate and sprue should be highly polished and all sharp corners removed. It has been found that rough surfaces in the gate will cause the material to swirl on entering the cavity which results in the most troublesome problem of creating striae in the lens.

The determination of the correct curvature of the inserts is a problem for the optical technician. The curves are determined from the specifications of the lens. The correct curve has to be ground on the inserts before polishing as the polishing fixture merely follows the curve and it is almost impossible to correct any discrepancy in the curve during the polishing operation.

Important details of mold construction

It is advisable to have all parts of the mold ground to assure proper fits and alignment. The inserts should be stoned around the periphery after hardening and before polishing to assure a press fit into the cavity. Fixtures and gages should be made to facilitate the mold building and further assure accuracy.

The most important phase of the construction is fixtures for the machining of the inserts and the cavities into which the inserts are assembled. In order that the axis of the curves be held in exact parallel and not rotated, these fixtures are necessary, as a possible error in the setup from one operation to another in the ma-

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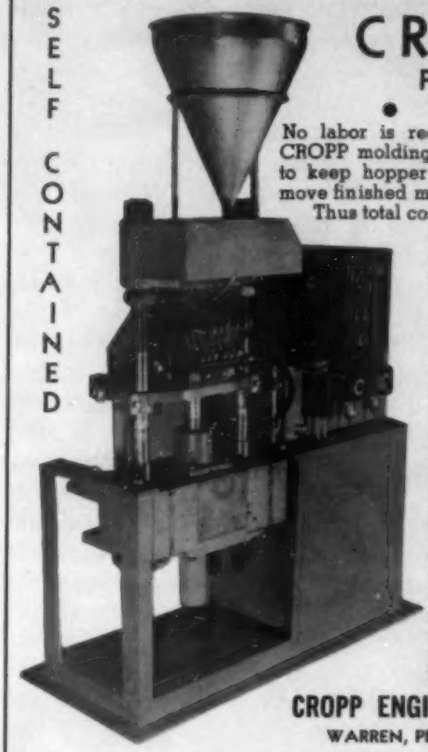

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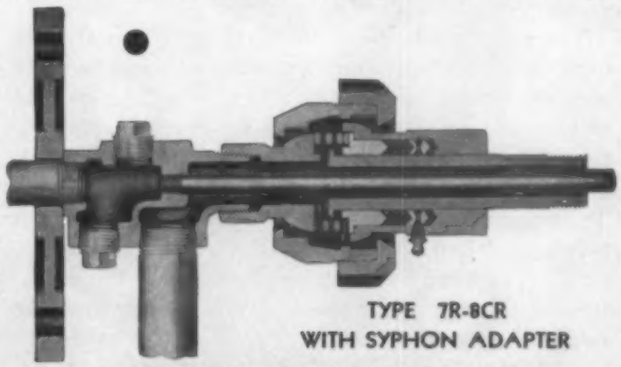

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chining operations would cause trouble. Each insert should have two locating holes or a key-way on the back side accurately located to assure interchangeability to be used for all the operations, the fixtures having corresponding locating arrangements. This is not important where the curve is spherical; however, it will help to maintain the optical axis.

The stainless steel inserts should be as hard as possible, drawing them only enough to relieve hardening strains. The entire mold should be assembled before the inserts are polished to safeguard against any fitting that might be required after polishing. After the mold has been completed to the last detail, the inserts are removed and polished. The curved surfaces should be ground with a very fine stone, as any coarse emery cuts will prolong the polishing operation. It has been proved that the least amount of polishing necessary, the more satisfactory the job.

The polishing is done on standard optical grinding and polishing machines. The same locating holes or key-way is used to locate the inserts on the polishing machine to assure perfect alignment. Care must be taken in the grinding that the same amount of steel is taken off the inserts on one side as on the other. It will be impossible to control this to perfection, hence the shim under the insert is needed to take care of this discrepancy. The final grinding and polishing should be done by a reputable optical manufacturer.

Assembly and tryout

As stated above, the polished surfaces of the inserts should not be touched. Great care should be taken in their assembly. To determine the thickness of the shims, the inserts are placed on a layout plate and with a height gage the high and low parts on the inserts are checked. The measurement should be taken at the extreme edge of the insert to safeguard against scratching. The shims are then ground to the proper thickness and assembled in the mold. The inserts are then assembled using cotton over the polished surfaces for protection while assembling.

The mold is now ready for a tryout. Several shots must be taken before any lenses are checked to make sure the inserts have taken a final set. The amount of checking necessary, depends on the lens specifications. In any event, unless the specifications are very broad, adjustments will have to be made to the inserts. There are several optical characteristics which cannot be changed by adjustments to the position of the inserts. The focal point depends entirely on the curvature of the lens and any correction in this direction means the reworking of the curves. If the axis is incorrect on an irregularly shaped lens, it means reworking the inserts. For slight changes in the position of the optical center and the reduction or increase of cylinder power or prism power, the inserts can be shifted one way or another. No set rule can be given for these changes as they depend on many factors.

It would be advisable for anyone who is undertaking lens production to purchase a suitable lens measuring instrument such as a Vertometer. The individual using equipment of this kind will not only have to be trained in its use, but will also have to learn to transpose its measurements into mechanical measurements for any correction to the mold.

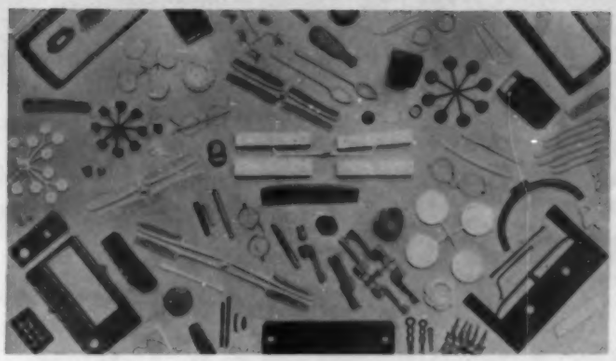
Production

Certain conditions must exist in the molding setup before production can be carried on with any degree of efficiency. The one question mark for success in lens production is the rejects. A well-made mold, corrected for the optical specifications of the lens, will always make good lenses as far as the optics are concerned. Aside from optical characteristics, a lens can be a reject for any of the following reasons: dirt particles, flow marks, striae, cloudiness, air bubbles and scratches. Going over these reasons again we find, much to our surprise, that they deal in molding technique. Here we have taken our highly technical job down off its high perch and put it into the category of an ordinary molding job. It is true that we will have to adjust ourselves to the better class of molding and we can eliminate a great share of the trouble by facing the fact that we cannot be too clean about the way we handle the job.

The first requisite is an air-conditioned room around the press. The air-conditioning is very important, and we do not mean a blower pulling air through a pipe set through a conveniently broken plane of glass in the window. The room around the press should be well made and air-tight. The air-conditioning equipment should consist of a blower with air filters large enough to keep the room under a slight pressure. This will allow the air in the room to be exhausted through the cracks around the door and other places and will not allow any dirt or dust to enter the room. Washed air is the ideal system to use as in the summer it gets hot in these enclosed rooms. This air-conditioned room will eliminate the largest share of rejects. Scratches are caused by improper handling and can be eliminated almost entirely by providing trays or racks to see them through the finishing operations. The remaining causes of rejects are dependent on the control of the molding operation. The hardest of all to eliminate in injection molding is striae, but by careful manipulation of the temperature controls, rejects for this reason can be kept down to a mimimun.

In compression molding the loading of the cavities should be done with powder loaders. These loaders should be made of aluminum or brass chrome-plated and highly polished so no dirt will adhere to them. Care must be taken to wipe off thoroughly drums of material before opening. The operators should wear clean clothes without pockets in the coat or jacket. Dirt drops from pockets into the drum when leaning over to scoop out the material. The scoop should be aluminum and highly polished and kept clean. All of these points may seem rather ridiculous, but all help toward keeping the rejects down. With proper setup one can enjoy a profitable venture into lens production.

Injection Molds



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Controlling mold closing

(*Continued from page 50*) pressure, there is danger of damaging delicate pins and thin mold projections. When pressure is applied and material starts to flow there is a natural tendency toward a balanced pressure within the cavity. Under high pressure this balancing of internal pressure takes place with a rush of material from one section of the die to another. The speed with which material flows past thin sections and delicate pins will not allow time for a sufficient build-up of back pressure on the same pins, thus setting up severe strains which sometimes cause damage.

By closing the mold only fast enough to follow up the normal speed of flow, the same equalizing of internal pressure takes place, but it is done under moderate pressure, eliminating the tendency for material to rush from one part of the mold to another. There is an opportunity for back pressure to build up against delicate mold parts so that when full pressure is applied, the internal stresses are in balance, supporting the parts.

Most molders have had unfortunate experiences in forming parts such as radio tube receptacles requiring molds with a solid central core and with a ring of delicate pins to form the holes for tube plugs. The solid plunger core displaces all material in the center of the cavity, causing a severe sidewise pressure on the pins. Pin replacements have been an important problem. For such parts, controlled closing speed is of value.

As has already been pointed out, when pressure is applied rapidly, flash material is extruded between punch and die cavity. During the time that flash is being extruded, full pressure is exerted directly on the material itself. After the mold is completely closed, however, the full pressure is transferred from the material to the land area or "stops" of the mold. At this point, if the closing action has been rapid, the entire mass of material may not have been fully plasticized. This is especially true of parts with thick and thin sections—the core of the heavy sections containing material which has retained some of its granular qualities. As the pressure is now exerted on the mold, there is not sufficient available pressure on the material to assure maximum density within the inner core. In such case, the shrinkage per unit of section will not be constant, greatest shrinkage occurring in sections of least density.

By controlled speed of closing during final compression, the molds do not close completely until the material becomes fully plastic. Thus, there is a steady limited pressure on the material during the plasticizing period and when full plasticity is attained, the mold then closes the remaining distance—still applying pressure on the *material* rather than the *land area* of the mold. This action assures parts of *uniform density*, which in turn means a uniform shrinkage factor. Government gage cases, for example, contain heavy base sections, deep, thin tubular walls and inserts. With controlled pressure it has been possible to produce them successfully, whereas, with former conventional methods, a prohibitive number of rejects resulted.

A.S.T.M. flow temperature test

(*Continued from page 58*) by loose bearings in a swing arm, rests on the material in the orifice. A flexible chain attached to the upper part of the follower rod is passed part way around and fastened to the small diameter of a two-step pulley having a three-to-one ratio and mounted on the swing arm. A second flexible chain passing part way around and fastened to the larger diameter is attached to a sliding indicator and a counterweight. The indicator travels over a calibrated scale so that the amount of flow in the orifice is shown on the scale, magnified three times. The weight of the flow-indicating mechanism is such that a pressure of 40 psi. is exerted on the material in the orifice; this however, is counterbalanced by sufficient additional weight on the pressure system, 5.

(2) *Optional.*—The flow measuring device illustrated in Fig. 1 may be equipped with a time clock, a recording pen, and suitable graph paper with the scale as one axis and time as the other so that the flow behavior over any given time period may be recorded.

Test Specimens

3. The test specimens shall be molded or machined cylinders $^3/_8$ in. in diameter and $^3/_8$ in. in height. The height may be obtained by piling up several disks.

Conditioning

4. (*a*) *Preferred Method.*—Test specimens shall be conditioned at room temperature in a desiccator over anhydrous calcium chloride for 72 hours.

(*b*) *Alternative Method.*—Test specimens shall be conditioned in an oven at 50 deg. C. for 24 hours.

Procedure

5. (*a*) A working pressure of 1500 psi. shall be used.
(*b*) The unit of flow time shall be 2 min. ± 1 sec. as measured with a stop watch or timer.
(*c*) The test specimens at room temperature shall be inserted in the hot charge chamber and tested immediately.
(*d*) Between tests, the orifice shall be swabbed with acetone or other suitable solvent to remove any residual plasticizer or lubricant.
(*e*) Each material shall be tested at three or more temperatures at which the flow will be within the interval of 0.50 to 1.50 in. with at least one measurement above and one below 1 in. Temperatures shall be controlled within plus or minus 0.10 deg. C. All temperature measurements shall be made at the split cone after it has come to equilibrium with the block.

Plotting Results

6. The linear flow shall be plotted against temperature on semilogarithmic paper. With the flow measurements plotted on the logarithmic coordinate and temperature on the linear coordinate, a straight line will usually result. The temperature at which the flow is exactly 1.0 in. shall be read from the graph and reported as the flow temperature.

Report

7. The report shall include the following:
(*f*) A statement indicating the nature of the material tested,
(2) Curve of linear flow against temperature (Section 6),
(3) Temperature at which flow is 1 in.,
(4) Report of any unusual behavior of the test specimens such as discoloration, sticking, etc., and
(5) Details of conditioning.

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WANTED: CELLULOSE ACETATE SCRAP, unground or reground, as well as lumps, also acrylic or methacrylic resin scrap and celluloid scrap. Send details concerning quantities and price. Reply Box 318, Modern Plastics.

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WANTED, for export, discontinued or used plastic molds for molding trays, bowls, plates, drinking cups. Must be in first class working condition. M. Pancorbo, 155 John Street, New York, N. Y.

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Design for plastic products

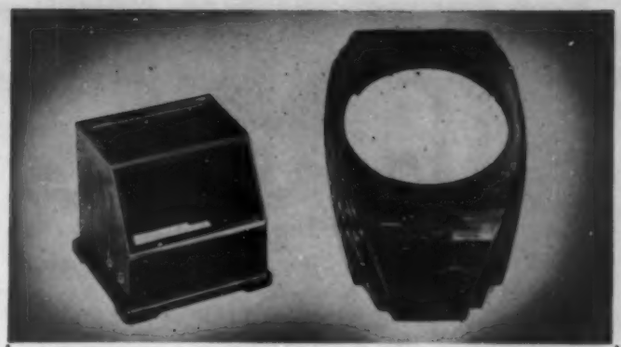
(*Continued from page 48*) the course of investigation we are often led to the selection of plastics because they solve so many problems of production, appearance and utility. There are certain inherent qualities which we immediately associate with plastics; namely, brilliant colors which go all the way through, thermal and electrical insulation, the ease with which complicated shapes are molded, and the satin feeling of the smooth finishes.

A fine example of what plastics can achieve is demonstrated in a bicycle tail light (Fig. 3). The housing replaces a glass and metal product. The new light is molded of cellulose acetate in two pieces—opaque body and translucent red lens. The pieces are then firmly bonded into a single unit with acetate. . .and if you've ever tried to open a cellophane-wrapped cigarette package, you'll know how tightly these pieces are joined and from what source we obtained our construction idea. The combined molding rests in a soft rubber cup. There are no rattles, rust, paint chipping or breakage because the acetate is exceedingly resilient and withstands shock.

When we were called in to redesign a waffle iron for a prominent manufacturer we immediately saw a possible improvement through the combination of the heat control and the jewel light. It was here that plastics came to our rescue quickly. The jewel light was formerly manufactured of imported glass, but in order to combine the two units, it was essential to find a material which would permit an accurate center perforation, transmit light, hold identifying lettering and, above all, resist high operating temperatures. A transparent red phenolic which met all these requirements was selected. The plastic handles remained unchanged as to material, although the etched nameplate formerly affixed to the metal body was put on to the handle for visibility.

Relatively high tool costs often preclude the use of plastics in a limited production item. In the instance of a permanent wave machine, we were able, through elimination of finishing operations, reduction in weight and facilitation of assembly, to replace the former chromium-plated metal housing with one of molded phenolic. These savings were great enough to allow the amortization of molds over a few hundred units, and yet show a net saving. In addition, the dials and nameplates are of illuminated urea formaldehyde. Because of its insulating properties, phenol formaldehyde was used for the knobs and curling elements.

The first molded radio cabinet was molded for Kadette in 1932. While plastics have solved many problems of cabinet construction, the sound quality of midget radios was always poor because of the small space in which the speaker was confined. Since the only way to increase the resonance chamber was to increase the cabinet size, we had to find other ways to improve the sound; this solution, as incorporated in the 1940 Kadette (MODERN PLASTICS, October, 1940, pages 52 and 92), was to mount the speaker toward a cone in the top. In this way the entire cabinet acted as a dia-



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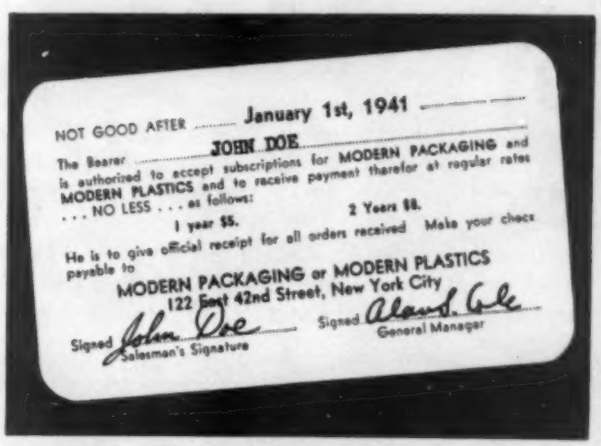
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phragm, and the sound waves radiating in all directions utilized the walls of the room as a resonance chamber. The advantages of plastics were maintained and sound deficiencies were kept at a minimum.

These are but a few typical ways in which plastics solve today's engineering and merchandising problems. I'd like to answer the question of what goes on during the design or redesign of a product. Let's consider a rather common product such as the Porto-Bar (Figs. 1 and 2), a portable bar.

We originally received the information on this job by means of a few rough sketches and a verbal description of what was desired. From this start we prepared a number of so-called preliminary ideas. These sketches represented the "thinking-on-paper" and were not submitted as final. From one sketch a certain feature was taken and added to another, from still another sketch a detail was borrowed, until after many conferences and discussions we ultimately arrived at what was accepted as the desired product appearance. Our next step called for blueprint details and dimensional models and these along with the sketches were turned over to the engineering department of a molding company. Further exploration into the manufacturing problems of the product brought about still further work on our part. A handle change, an addition to the decoration of the base and several other details all requiring our counsel, were necessary.

An idea of the caution with which we regarded every move might be partly reflected in the fact that two-cavity molds for this job cost approximately $7,000 and weight of the raw steel blocks was in excess of 2600 pounds. The material selected for this product was a phenolic, and the weight of a single piece is slightly over 5 pounds. Handles are molded separately and assembled. The whole works sells for $9.90.

Every productive activity depends upon premeditation to insure success and it is not amiss that we should glance into the future. I do not subscribe to the "Buck Rogers" prophecy; within our lifetime it is improbable that people will be designated by number, fly to the moon or otherwise suddenly alter our ways of living. While progress will be swift, it will no more unbalance our lives than stratosphere and inter-continental flying, television, X-ray or plastics have done to date. It is, imperative that we keep abreast of every new plastic development, considering no current limitation as permanent—tomorrow may bring the answer.

Phenolic laminated for X-rays

(*Continued from page 49*) tion against X-radiation had to be met by new methods of production. The incorporation of oxides or salts composed of high atomic weights in the laminated stock is the essential principle for providing such insulation. Such compounds may be incorporated in the paper as a filling material or may

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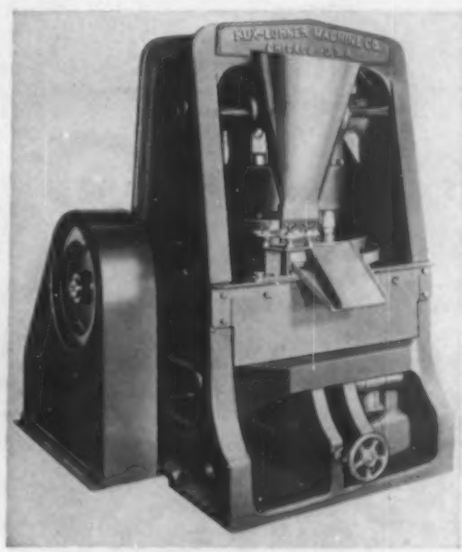

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be suspended in the varnish used during impregnation. Special techniques are of course required and new problems of manufacture are introduced when such materials are used.

X-ray phenomena take place when a cathode ray which is a stream of electrons impinges against a metal plate. This impact of electrons at the surface of the metal excites light of exceedingly short wave length. This light is designated as X-rays. This action takes place in a highly evacuated glass tube and the beam of X-rays produced at the metal cathode is projected through the glass tube into the anatomy of the patient, in the practice of deep therapy; and through the patient onto a special photographic film, when pictures are required.

These rays owe their penetrating power to the fact that their wave lengths are less than the inter-atomic distances in the molecular structure of the substances which they traverse. In practice, these X-ray tubes must be moved with ease and facility so that various parts of the body may be exposed to the action of their rays; at the same time, the operator of X-ray equipment must be adequately protected against severe burns that they may produce. This protection with the required flexibility of motion is provided by enclosing the X-ray tube within a specially constructed Dilecto laminated tube into whose structure the protective action of desirable salts and oxides has been incorporated.

The protective action of such laminated tubing can be varied at will. Protective action is usually designated in lead equivalents, i.e., equivalent to a desired thickness of lead. The following brief tabulation gives an indication of the wall thickness of X-ray Dilecto tubing in relation to equivalent sheets of lead.

Thickness of X-ray Dilecto, in.	Equivalence of sheet lead, in.
3/16	0.045
1/4	0.060
3/8	0.085

Other insulation problems involve merely the necessity of protecting electrical current carrying parts. X-ray equipment operates at a very high frequency at reasonably high voltages. An insulation of low-power-loss characteristics must therefore be provided; otherwise, excessive heating will take place in the insulation and the insulation may be destroyed.

Laminated X-ray insulation, such as sheets, rods, and tubes, can be provided with a power factor of 2.5 to 2.75 and a power loss of 9 to 12 at high frequencies. These intricate technical services must be performed with a material that provides an atmosphere of beauty and luxury. We have in this instance an example where beauty, quality, ruggedness, dielectric properties, physical properties, and unusual resistance to X-ray penetration of phenolic laminates have proved of valuable aid in meeting a specialized and highly technical need.